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ELECTRICAL EXPERIMENTER

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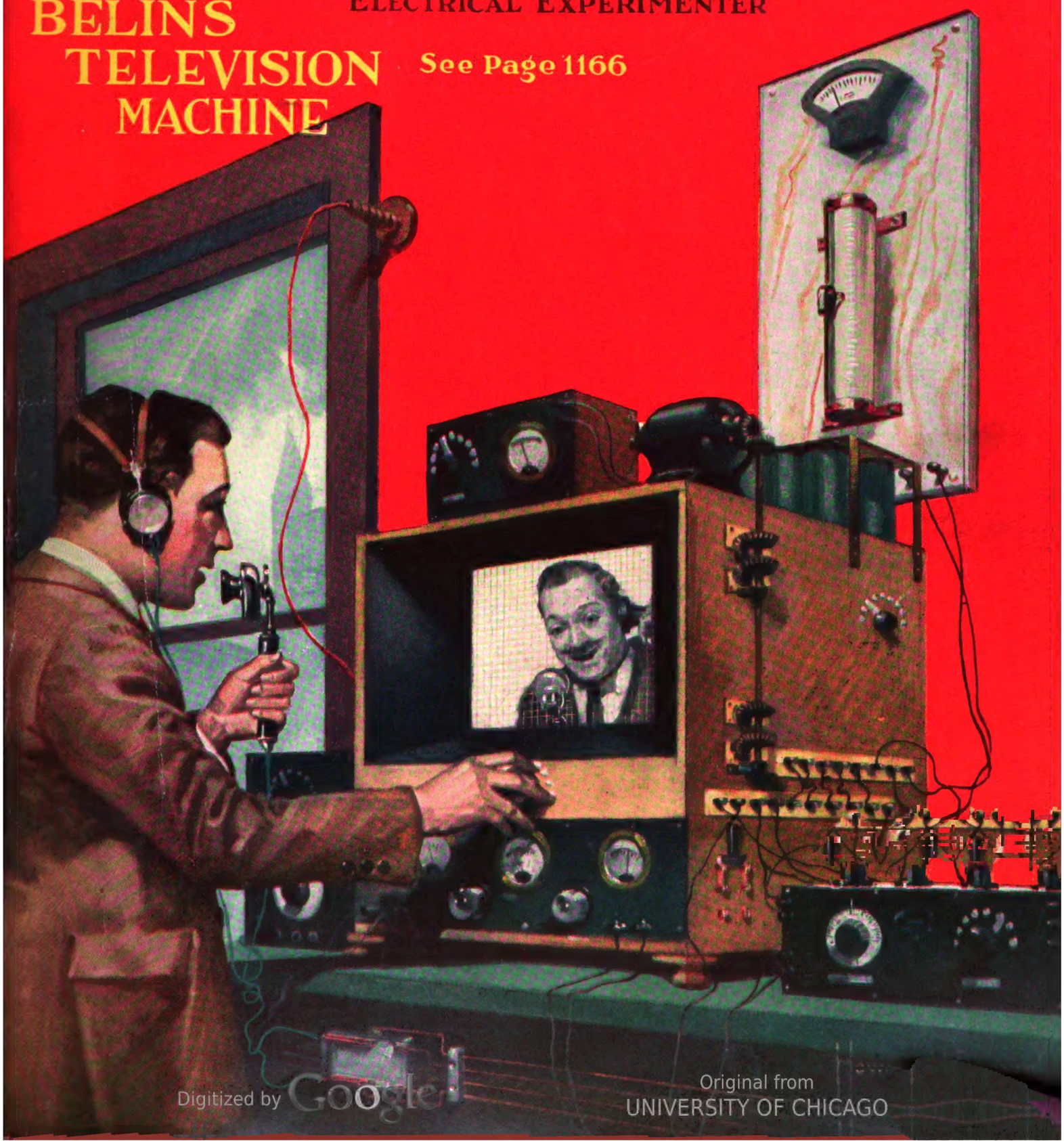

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FORMERLY

ELECTRICAL EXPERIMENTER

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Every man who looks back upon the past few decades in the industrial history of America can see at a glance that each new discovery of Science has brought into existence a countless number of new professions, each with their highly-paid specialists.

New discoveries in the field of electricity, for instance, have created positions for specialists in electrical engineering, telephone and telegraph, radio and other branches too numerous to mention.

And now come other important discoveries in an entirely new field—discoveries which have brought into existence the need for men trained to a new profession which renders a great and appreciated service to the public, and a service for which the public is willing and glad to pay high rewards!

In fact, men who are already practicing this new profession are making from $60 to $300 a week. And the profession can actually be learned and mastered in from 2 to 6 weeks!

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To the man who wishes to become established in a profitable business of his own, but who has not the capital or financial backing usually required, this new profession offers unlimited opportunities. This is because you become affiliated with a strong Association Headquarters in New York City, which trains you in the profession, finances you after graduation, makes you its representative in your community, and keeps in constant touch with you, giving advice and business co-operation.

Furthermore, this new profession offers its followers a position of dignity and independence, a free rein for initiative, and those other recognized advantages enjoyed only by professional men. Yet there is no long period of training and study, extending over years; no poorly paid period of apprenticeship, as in the case with doctors, lawyers and followers of the old-time professions. And best of all, there is practically *no competition!*

This is one reason why those men who are now practicing this new profession are actually making more money than the average doctor, lawyer, architect or engineer!

Why Such Opportunities Are Possible

The idea back of this new profession is briefly this:

It is conservatively estimated that over $300,000,000 property loss is occasioned annually from insects and rodents that infest offices, ships, warehouses, private homes and buildings of all kinds. Then, too, there is the annual loss to crops and to live stock and poultry, due to the ravages of plant parasites and pests of all descriptions, which is so great as to be almost beyond calculation.

What has been done to combat this damage to private and public property caused by these parasites of the insect world?

Practically nothing, save the efforts of the U. S. Department of Agriculture and Forestry, whose skilled entomologists and scientists have waged war on the Gypsy Moth, the Boll Weevil, and other national menaces.

The private individual has been left to his own resources. Property owners, farmers and householders have had to rely upon ineffective commercial preparations. With few exceptions these "sprays," "insecticides" and "powders" are worthless in meeting conditions.

The scientific exterminating of insects, vermin and parasites is a highly specialized work. It demands a knowledge of technical methods and special formulas. Until recently these methods and formulas were unknown. But Modern Science has discovered secret formulas, has devised accurate, well-defined plans and methods by which crops, trees and private property can now be saved from damage, destruction and contamination with the same degree of certainty and safety as germs and infection are exterminated by the skilled methods of the physician and surgeon.

These new discoveries in the field of Exterminating Engineering have created a tremendous demand for men trained to this work of sanitation and public service. Those who have already taken advantage of this new field of opportunity are highly respected professional men in their communities. And their earnings are equal to, or even greater than the average remuneration received by experts in other professions.

Profits Come Quickly

Exterminating Engineers have no difficulty in getting business. It *comes* to them as soon as it is known that they can get results when other methods fail. Property owners, farmers, florists, business men and householders are glad to pay large fees for having their premises freed from the ravages of destructive pests and parasites. This is why the Exterminating Engineer makes from $60 to $300 income a week, right from the start.

But the man who chooses this new and lucrative profession is not dependent solely upon his individual efforts.

The Exterminating Engineers of America—a co-operative organization whose membership consists of men trained in this profession—maintains its Headquarters in New York City, where they teach men *by mail* and graduate them in from 2 to 6 weeks as Exterminating Engineers. Then they help finance them in business, appointing them their representatives in their own communities. No capital is required. The purpose of the Exterminating Engineers of America is to maintain representatives in all parts of the country who by practicing these exclusive methods can *guarantee* satisfaction to customers and thereby render a great and humanitarian service to mankind.

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There are great opportunities ahead for the representatives of the Exterminating Engineers of America. No profession can be learned so quickly—few professions offer equal promise of financial independence.

The Exterminating Engineers of America are always on the lookout for live, progressive men to become affiliated with them. The membership fee is ridiculously low—a man can actually become established in business for himself as an Exterminating Engineer, at a lower outlay of money than the average Freshman in college has to pay for text books and supplies alone.

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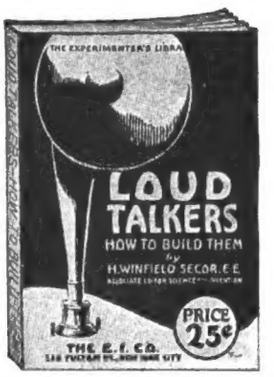

LOUD-TALKERS
HOW TO BUILD THEM

By H. WINFIELD SECOR

Associate Editor of Science & Invention

This book describes how to build two distinct and different types of radio loud-talkers, which can be built with either electro-magnetic field to be excited from storage battery, as well as permanent magnet field requiring no separate battery excitation. The third chapter deals with improvised loud-talkers and gives clear and complete instructions on how to build suitable horns for use with radio receivers of the Baldwin and other types. Several elaborate hook-ups are given of the author's own radio receiving set, comprising one stage of radio-frequency, detector and three stages of audio-frequency amplification, together with all the connections for the loud-talker.

Complete data is given for all the parts of the loud-talkers, including the field magnet windings, as well as the diaphragm or moving coil windings, and also the step-down transformer to be connected between the vacuum tube amplifier and the loud-talker proper.

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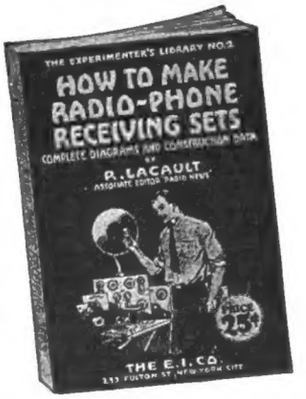

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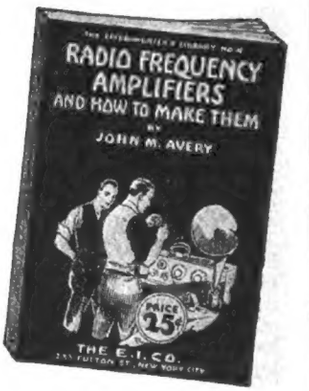

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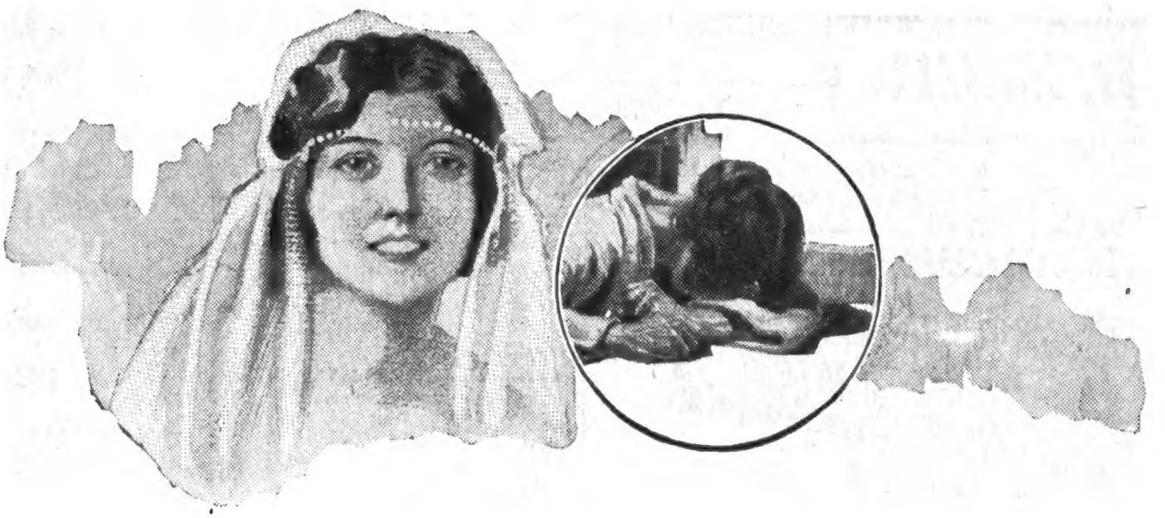

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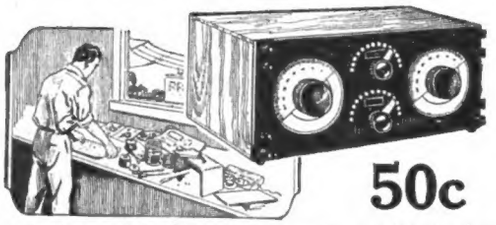

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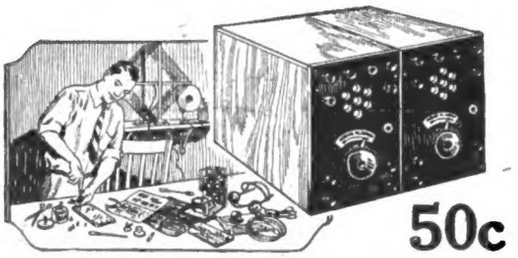

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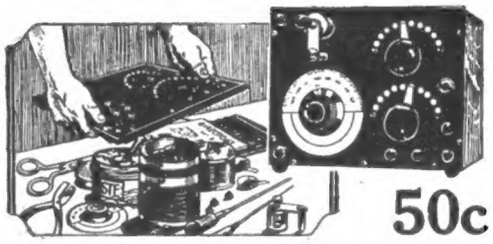

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The Second Mate — **H. Bedford-Jones**
Peril and mutiny on the China Seas. When every scupper was running red, and with two white women at the mercy of a villainous crew composed of the sweepings of the outermost islands, Jim Barnes, realized the gage of desperate battle he had accepted when he signed on as second mate of the SULU QUEEN.

The Devil's Payday — **W. C. Tuttle**
A sky of brass, the sun a flame,
And the land no place to dwell;
The only spot that God forgot,
A hunk of earth, so doggone hot
That it still belongs to Hell.

The Canyon of the Green Death — **F. R. Buckley**
Who were the devils in human form whose haunt was the lost barranca? Invisible, terrible, they brought the redoubtable young officer of the law to a strange dilemma. The law of the land commanded him not to desert his prisoners; the law of the desert ordained that he stand by his companions. Which did the Fates decree he should obey?

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Volume X
Whole No. 120

Science and Invention

APRIL
1923
No. 12

H. GERNSBACK, EDITOR AND PUBLISHER
H. WINFIELD SECOR, ASSOCIATE EDITOR
T. O'CONOR SLOANE, Ph.D., ASSOCIATE EDITOR
Editorial and General Offices, - - - 53 Park Place, New York

"Those Who Refuse to Go Beyond Fact Rarely Get As Far As Fact"--HUXLEY

Money for Ideas

WE have mentioned frequently, editorially and otherwise, in this journal, that it is ideas that make the world go 'round. In this country particularly, ideas are more valuable than in the rest of the world. The civilization of the United States has been built up primarily on a foundation of ideas and the applied inventions they led to. Fortunes upon fortunes have been made from simple ideas applied to everyday life, and all about us we see the same thing happening every day, where people who know how to think make fortunes from their brain children.

In a country where the public welcomes every new wrinkle, every new stunt, every new idea, it would seem that every one of us should become a millionaire over night if he only took the trouble to think out something new and useful. This theory is perfectly correct, but the great drawback is that but few of us really think out new things. Continuous thinking and planning means a huge effort, and few of us cherish such a task. It is far easier for the mind to run along in its accustomed grooves than to exert itself unduly.

Perhaps future generations will be trained systematically how to think, at least constructively, for an hour each and every day. Until such a time comes the world will have to move on in its well-worn tracks.

And when you come to think of how many improvements there are still to be made all about you, it really is astonishing that the patent office at Washington, D. C., issues less than 3,000 patents a month. If only a small fraction of the population would put its mind upon improvements, there would be at least 100 times as many patents issued a month as there are now.

The advice to would-be inventors is simple: Look about you and think! Watch for petty annoyances and see how you can diminish them, or do away with them altogether. Look for the things that consume time, and then think hard how you can reduce this loss of time by inventing something that accomplishes the task in half the time or less. Then, if you have worked out the device, consult a good patent attorney and if possible try to obtain a patent. If you don't know much about business or if your inclinations do not run to business, do not attempt to manufacture a device under any condition; sell the patent, or try to license it to a manufacturer. You will make more money in the end. Many good inventions fall by the board because inventors, as a rule, are not business men, and do not know how to get the most from their patents. If you can not sell the patent, nor license a manufacturer, then the next best thing is to sell an interest to a business man who knows something about the article or similar articles.

Do not be afraid that a patent attorney will do you out of your ideas. The writer does not know of a single case where an inventor was defrauded by a patent attorney, as patent attorneys follow certain routines, like any other well-established business, and pay little attention to the possibilities of any invention, and if they do, there are certain professional ethics that will certainly prevent any attorney from doing under-hand work. It simply is not done.

Furthermore, remember that when you start inventing, it is well to pick out the small, simple things. Big ones run into money and unless you have a lot of it to spend, the small article, as a rule, will prove to be the money-maker.

So much for theorizing. Here are a few items that you might think about. Each one of them, if properly solved, is worth a fortune.

If you are a man, you probably realize that you have expended more profanity over your collar button than over any other inanimate object that you can think of. Collar buttons, however, have been made practically the same way as you wear them now, probably since the time of Tut-ankh-amen. There ought to be something simple that bears no resemblance to the present collar button. Some day a genius will come along and show us a solution. He will make a fortune if he goes about it rightly.

Your shoes are the next great time-consumer. If you add up the time that it takes to lace shoes in the morning and unlace them in the evening, you will be very much astonished. Shoes have been laced in the good old-fashioned way probably since the time that Adam first left Paradise. We have become so accustomed to the shoe lace idea that we never think seriously about it. There must be some way of lacing shoes in a totally different manner from that used today. This holds particularly true of high shoes. No one objects to shoe laces because they are better than buttons and similar substitutes, because with shoe laces, as the shoe gets larger and larger, due to wear, the laces take up the slack, which is as it should be. But there should be a way of fastening shoes much more quickly. Suppose you think about it!

If you are one of these individuals, and there are millions of them in this country, who require an alarm clock to get up by in the morning, you no doubt have found that after a while your auditory nerves become so used to an alarm clock that you no longer hear it in the morning. Your auditory nerves have become so habituated to the same gong, or noise (if you wish), that they no longer re-act. Why not make an alarm with a gong that can be changed in pitch, or otherwise adjusted, so that it will give you a dozen different sounds with a simple adjustment? Or it could even be automatic. Every time you wind up the alarm, the gong, by some simple adjustment, could be tuned or otherwise adjusted, giving a different sound in the morning. The alarm clock manufacturers would pay a fortune for such an idea if the idea was the correct solution and did not make the alarm clock too costly.

We have used our present-day erasers probably since Columbus discovered America. Erasers are unsanitary and really foolish when we come to think of them. Just because some misguided inventor, ages ago, discovered that carbon, either from a pencil or from a typewriter ribbon, could be erased by means of rubber, there is no necessity for using that idea until the end of the world. There must be some sort of an eraser that will erase the lead or the carbon impression, or, for that matter, ink, by some chemical method, instead of mechanically rubbing it, as we do it now. When we *do* rub, we rub away more paper than impression. The result is that the paper becomes thin and sometimes there will be a hole. Our desks and our machines after a while become filthy with such erasings. Who will deliver us from the present-day rubber eraser?

When you pick up your favorite magazine, whether it is SCIENCE AND INVENTION or other bulkier ones, you find that the binding, as a rule, interferes with your reading. The staples that hold the pages together grip the edge of the magazine like a vise. When you lay the magazine down flat and do not flatten it out by using several H.P. in the attempt, it closes up on you. Big magazines are very tiresome on the hands, because you cannot fold them in the center. The center stapling, such as used by the *Saturday Evening Post*, for instance, cannot be used to advantage on very much bulkier magazines, although center stapling is, perhaps, the best. But there should be some way whereby a thick magazine can be bound cheaply so that the magazine can be folded in the center without the pages coming loose. Many attempts have been made at such improvements, but as a rule they are too costly and publishers fall back to the side wire stitch, as is used, for instance, on this magazine. But there must be some solution to the problem. The inventor will reap a harvest.

H. GERNSBACK.

ANNOUNCEMENT

In connection with the above editorial, we wish to announce a special feature, beginning with the next issue. We shall run a special series of articles showing how inventors of simple things have patented their ideas and are now making good money from such ideas. The inventors themselves will tell their stories for the guidance of our readers, and we have no hesitancy in saying that this is one of the greatest series of constructive articles that we have ever published.

If you are at all interested in cashing your ideas, or if you are contemplating taking out a patent, these articles will be of the utmost help to you.

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Making Rain With Electrified Sand

THERE have been many inventions, both electrical and mechanical, in the past generation or two, with the avowed purpose in the minds of the inventors of producing rain at will, or of dissipating fog. The latest invention for annihilating clouds and fog and for producing rainfall as well, is based upon the dropping of a small quantity of electrified sand from a fast airplane or planes moving above the clouds. Dr. Wilder D. Bancroft, Professor of Physical Chemistry at Cornell University, and Dr. L. Francis Warren, have devised this unique method of accomplshing what has heretofore seemed almost impossible.

The sand fed out of a hopper carried aboard the plane is being charged with a current at a potential of about 10,000 volts, just as it leaves the nozzle. The electrified sand then spreads out over a considerable area by the wind action of the plane's propeller. The pilot has a convenient switch for changing the polarity from positive to negative, and the high tension electric charge required is supplied from a wind-driven dynamo mounted on one of the wing struts. Dr. Warren has estimated that he could clear up a London fog with one airplane in about thirty-five minutes, by discharging electrified sand into the fog from above. Dr. Warren said:

"The basis of the new process of fog annihilating and rain making is the theory that when a negative particle in colloid solution is brought in contact with a positive particle, the two are precipitated. The cloud may consist, according to this theory, of droplets of water carrying a negative charge. The rainmaker sprays such a cloud with positively charged sand. Water condenses on each particle of the sand. This becomes a positively charged droplet. Being oppositely charged, the natural droplet and the artificial droplet attract each other like magnets. They unite. Their combined mass gives them weight enough to fall by gravity. They pick up other droplets in their descent through the moist cloud; they grow into globules of substantial size and fall as rain. It is generally known that rain falls naturally only when the water of the air has condensed on dust particles. This dust is present in sufficient amount to form the basis of rain in all parts of the world."

If the electrified sand particles are scattered or repelled from the roof of the cloud, the flier knows that he is using positive sand on a positive cloud or negative sand on a negative cloud. The pull of a switch makes the necessary change in the electrifying apparatus, and a blast of oppositely charged sand is released. The the cloud begins to disintegrate. Daylight begins to shoot through holes in it. If conditions are right rain falls.

They also have a plan worked out for manufacturing the clouds and then transforming them into rain, which process is described as follows by Dr. Warren:

"For example, instead of using dust particles, it may, in certain cases, be desirable to employ positive or negative ions as condensation nuclei. Since ions are extremely

(*Continued on page* 1222)

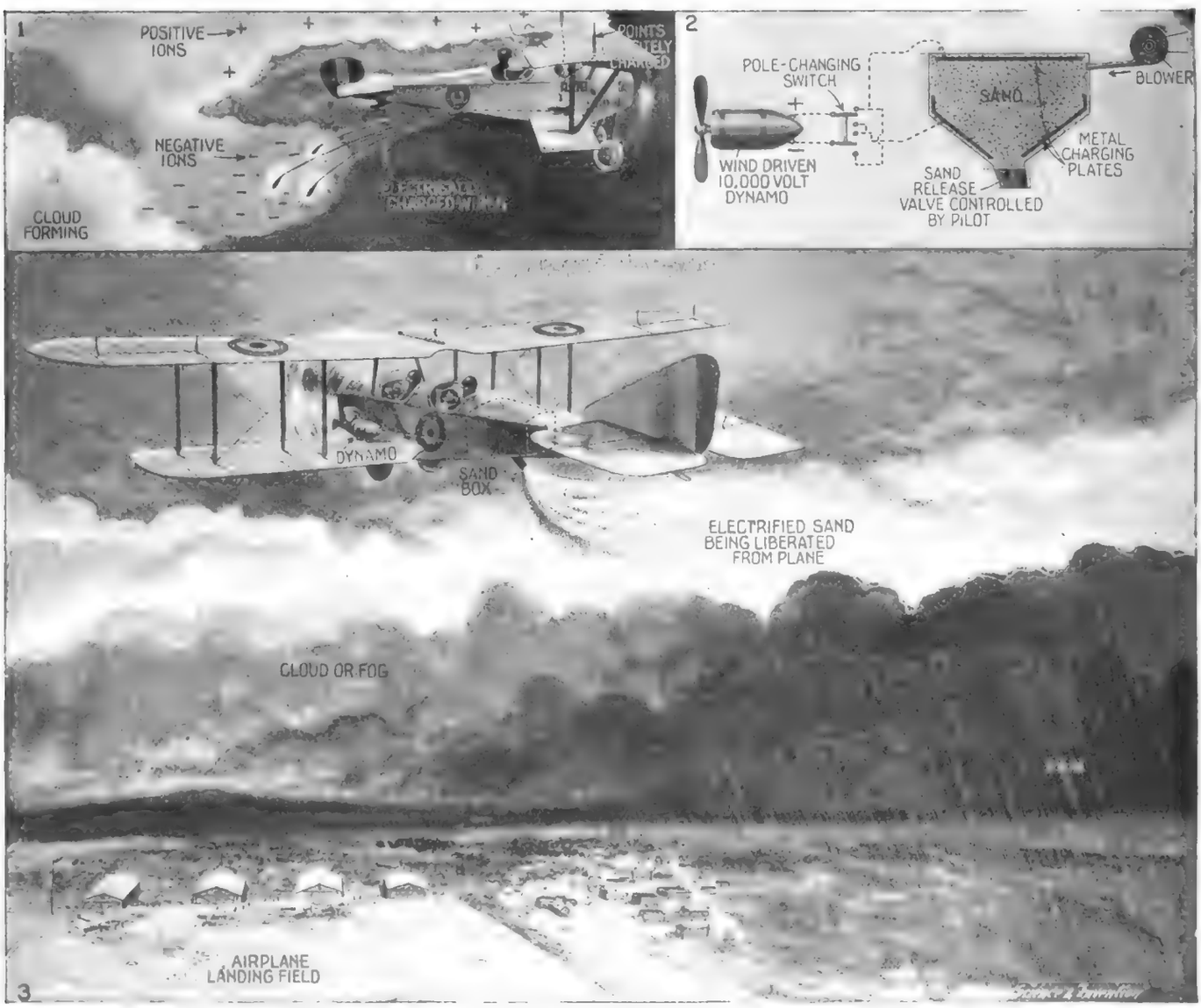

Fig. 1 Shows Electrical Scheme Proposed To Form Clouds, Which Are Then To Be Precipitated or Caused To Fall As Rain By Spraying With Electrified Sand, As Shown In the Lower View, Fig. 3. Fig. 2 Shows Detail of High Voltage Dynamo and Sand Container With Blower. This Electrified Sand Scheme Is Expected To Prove Valuable In Dissipating Fog or Smoke. It Will Prove Extremely Worth While For Airplanes and Ships In Time of War, As Well As For Causing Rain In Arid Parts of the Country.

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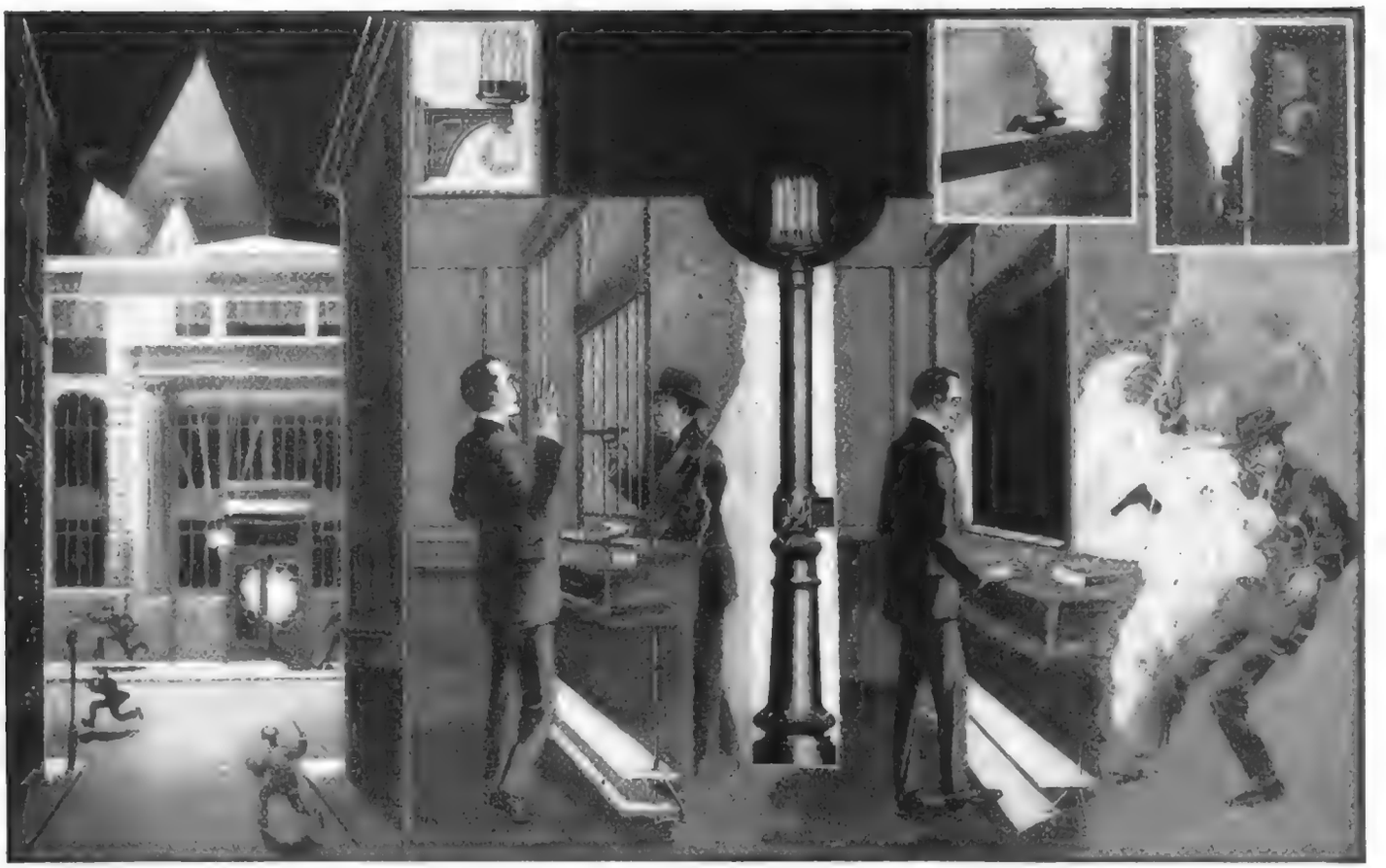
Gassing the Burglar

By ERIC A. DIME



Burglars and bank robbers beware! Here is the latest invention involving the utilization of war gas, together with a noise producing cartridge, and a device for firing rockets which turn into parachute star shells, all of which is calculated to either overcome the thief as he tries to jimmy a door or window, as well as to alarm the police and watchman. The rockets indicate and illuminate the location of the robbery. This gas shell device is designed and built in several sizes for use in private homes and garages, as well as for public buildings.

SHOCKED, gassed, marked, deafened and possibly pinched, are the surprises in store for the thief who tries to run the gauntlet of the latest burglar alarm. This sounds as if the enemy of society found himself in a sort of "No Man's Land" during wartime, while engaged in his precarious "trade" of breaking into buildings in quest of loot. As a matter of fact he does subject himself to some of the conditions of war, if he tries to rob a house that is protected with a P. A. B. Alarm. In other words this is the Pyrotechnic-Asphyxiating-Burglar Alarm, and it is a peace time application of some of the weapons of warfare employed by the armies in conflict during the late European struggle.

The man responsible for this invention is Joseph Menchen, Jr., who held the position of Technical Adviser to the Trench Warfare Research Department and to the Minister of Munitions of War in the British War Office. He was the inventor of the liquid fire, tracer bullet and aerial torpedo timers used by the British in the World War. Mr. Menchen's war experience led him to invent a burglar alarm, which would make it practically impossible for a crook to rob a home, store, bank, or any other building containing money or property of value. It is a matter of fact that the ingenuity of thieves has kept apace with inventive genius, which has contrived devices for the protection of property, and the result has been that buildings protected with "burglar alarms" have been robbed time and again.

The P. A. B. Alarm is a radical departure from other alarm systems and the crook who hopes to beat this latest invention will have to be a super-being. The device is designed to be placed on a door near the lock, window, or near any other entrance to a room or building. The mechanism contains a blank cartridge, which is discharged with the pulling of a trigger. The size of the cartridge may very according to the class of building that is protected. A No. 38 cartridge is used for private residences, a No. 45 Gatling for stores and offices, a No. 10B for garages, and a No. 1½ inch cannon for banks, warehouses and isolated buildings.

The alarm is so placed that the "jimmying" of the door, window, etc., will discharge the cartridge which makes a loud report. The large size cartridges are bound to attract the attention of the police or other persons in the vicinity, or a few blocks distant. Forming a part of the alarm is a metal cylinder which contains a powder producing an incapacitating gas, and this gas is generated on the instant that the cartridge is discharged. The gas immediately fills the room, in which it remains like a heavy, yellow fog for about three hours. While not causing any permanent injury to a person the gas produces tears and a choking sensation.

One can well imagine the sensation the burglar experiences as he runs into these surprises. In the first place he will be shocked by the discharge of the cartridge, the report of which makes him temporarily deaf. If he then has the nerve to enter the gas-filled room he will be helpless because he is unable to see anything and the pain he experiences will make him beat a hasty retreat. Another feature which the crook will not fancy very much is the fact that the gas leaves a yellow stain on his clothing. He becomes a marked person. The result is that should he luckily escape for the moment he may be apprehended later through this tell-tale mark on his wearing apparel. The nature of the gas is such that it does not damage food, fabrics or any other articles found in the gas-filled room.

Another feature of the P. A. B. Alarm, which has just been introduced in this country, is a signal system which informs a community if a robbery is attempted on one of its buildings. This feature is an apparatus in the form of a candelabrum which is affixed to the outside wall, or placed on the roof, of the building protected by the alarm. The candelabrum may also surmount a metal post, resembling that of a street lamp, and placed near the curb of the sidewalk adjoining the building. The candelabrum contains a number of cartridges, say, from six to a dozen, which fire star-shells into the air. As soon as the cartridge in the building is discharged, it immediately ignites the outside candelabrum cartridges by means of a rapidly burning fuse in a conduit. The star shell cartrides discharge every twenty seconds for a period of three and a half minutes, and each star shell rises to a height of 1,500 feet and burns for one and a half minutes. Each star shell

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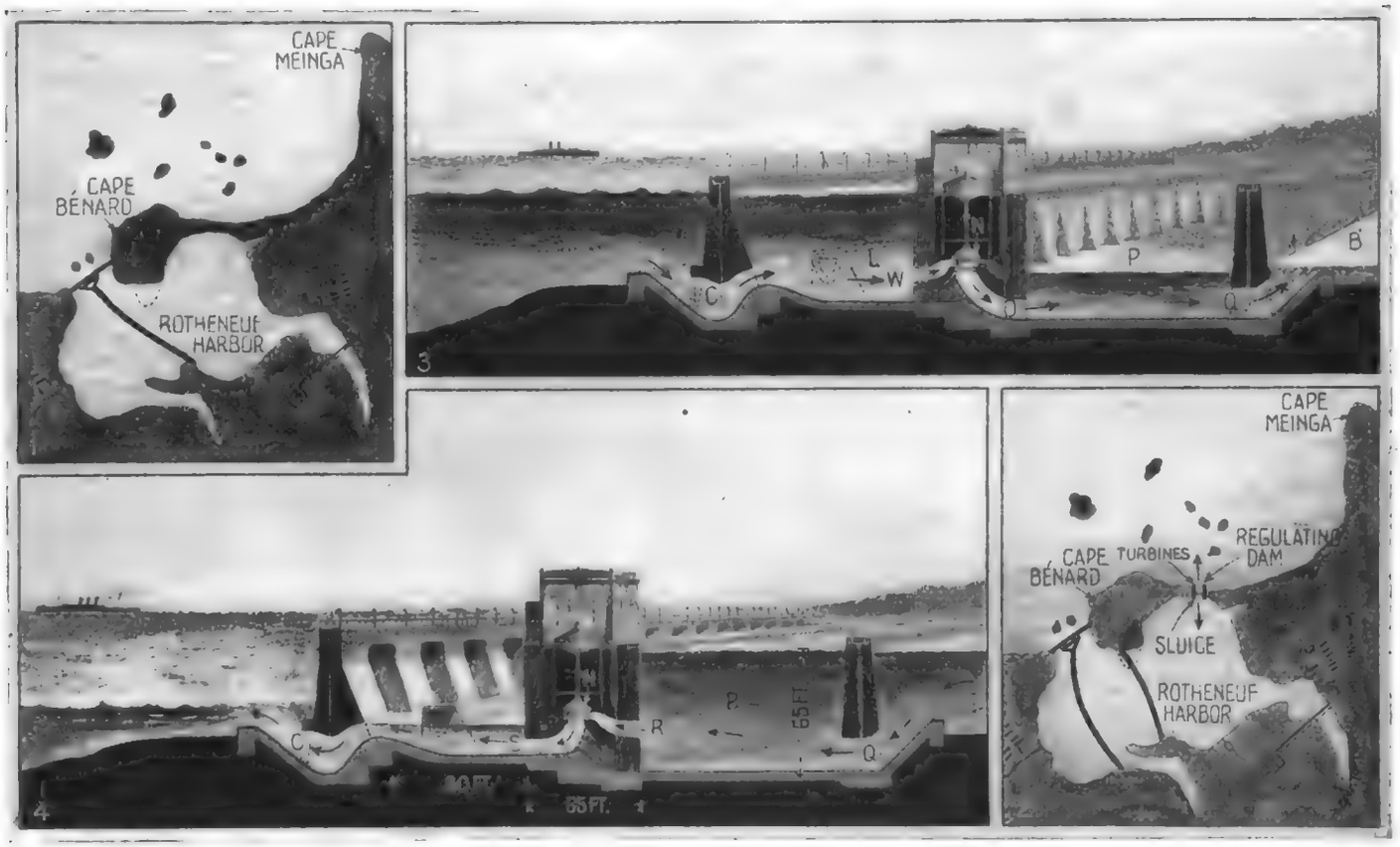

The Illustration Above Together with the Two Map Views, Show the Latest Tidal Power Plant Scheme Proposed for the Bay of Rotheneuf, and Cape Benard on the French Coast, Where the Tide Has a Rise of About Forty-Two Feet. In Fig. 3 the Arrows Show the Passage of the Water Through the Turbines Driving the Electric Dynamos, Through the Outer Breast Wall C L, Through Turbines M, Thence Through O, P, Q, and Into Inner Storage Basin B. In Fig. 4 the Reverse Action on the Fall of the Tide is Shown by the Arrows. Here the Water Passes from the Inner Basin Through Q, P, and Inlet R, to the Turbine N, Thence Out Through Discharge Opening S, and Wall C, to the Ocean. Suitable Valves or Gates Enable the Turbines to Be Operated with the Water in Either Direction as Becomes Necessary.

Utilization of Tidal Power

THIS problem, on which various articles have been published in England and France, is the object of intense theoretical and practical study. *L'Industrie Electrique* has followed up the English *Engineer* in treating on the topic, and the writers have gone back to the year 1790, in studying the history of the subject. From these investigations we learn again that it is oniy through auxiliary storage supply that a successful result can be expected and only in places in which favorable conditions of the coast, such as natural bays, supply the absolutely essential requirements.

As formerly, and as also explained in these columns, the articles concerned themselves with the lay-out and development of power of a single reservoir discharging directly into the sea, and also with that of two reservoirs, working in unison with each other, and coupled for all states of the tide. This last case is of special import from a practical and economical standpoint; it indicates the possibility of uninterrupted development of power. The lay-out of a tidal power work in the bay of Rotheneuf and Cape Benard on the French coast, comes into consideration, where the tide has a rise of thirteen meters (about 42 feet). The superficial area of water covers 287 acres. Figs. 1 and 2 give the ground plan of the general arrangement; Fig. 1 with the two divisions, P and R, without auxiliary reservoir, and Fig. 2 with hydraulic auxiliary for the time of slack water, so as to secure a constant development of power; the basis of the arrangement is also shown in section, Fig. 3. The action is as follows: The waves are broken by a breakwater which secures a quiet intake of the tidal waters, the inverted siphon is of the form shown, so that waves of the sea trying to penetrate, are directed against a body of masonry L, which annihilates their internal energy. The water then goes through the passage W, to the turbine N, and then goes through the passage O, into a reservoir P, and hence through the passage Q, to the feeding reservoir B.

The return of the water (see Fig. 4) when beginning on the ebb tide is through the canal Q, through the reservoir P, the channel R, the turbine N, the channel S, and the siphon C.

The mean yearly delivery of power is 5,600 horsepower, the maximum horsepower is 12,000 horsepower, so that in order that at the time of slack water the power shall not be reduced to 1,900 horsepower, a substitute power is drawn upon, which may be steam engines or Diesel, or from an independent water-power plant that works in combination with the tidal station, as is shown in Fig. 2, referring to the reservoir S. The last is less favorable as it brings about the reduction from 12,000 to 5,000 horsepower. The cost per unit is perceptibly increased. A reenforcement of steam or internal combustion engines is to be highly recommended. The following table of figures gives the economic aspect of the plant.

It is known that the Bay of Rotheneuf presents rather favorable conditions for the utilization of tidal power. The conditions in the Morlaix River present a still more favorable lay-out. Here 80,000 horsepower can be delivered, and the reservoirs cover an area of 30,000 acres. In France it is also proposed to use the advantageous combination of tidal power with that derived from the current of a river. If today the necessity, or at least the utility, of a subsidiary plant of current power installation is recognized, and if this auxiliary, the working in unison of high and low pressure installations, mountain rivers of high and low level, canal-lock, and steam or internal combustion engines, is installed, we must realize that the lay-out for the auxiliary operation of tidal power will be better in proportion as the changes in the intensity of power and the periodicity changes can be done away with, or at least can be limited in their range. But the most important of the fundamental things in economic power development are the questions of development and time, especially in the operation of electric power lines. The intervals of slack water in tidal plants are much shorter than the long dry periods affecting rivers. The rivers are also characterized by uncertainty and irregular operation. Hence it follows, that the minimum size of the auxiliary works for the development of river power and the duration of their necessary operation cannot always be definitely determined, a circumstance that naturally influences unfavorably the cost of installation, of operation, and of development, and makes the economical calculations very unsafe. But in the case of tidal installations the necessary assistance of auxiliary plants, the period of use and length of duration of their work, is perfectly known, so that the question of costs rests upon very safe ground.

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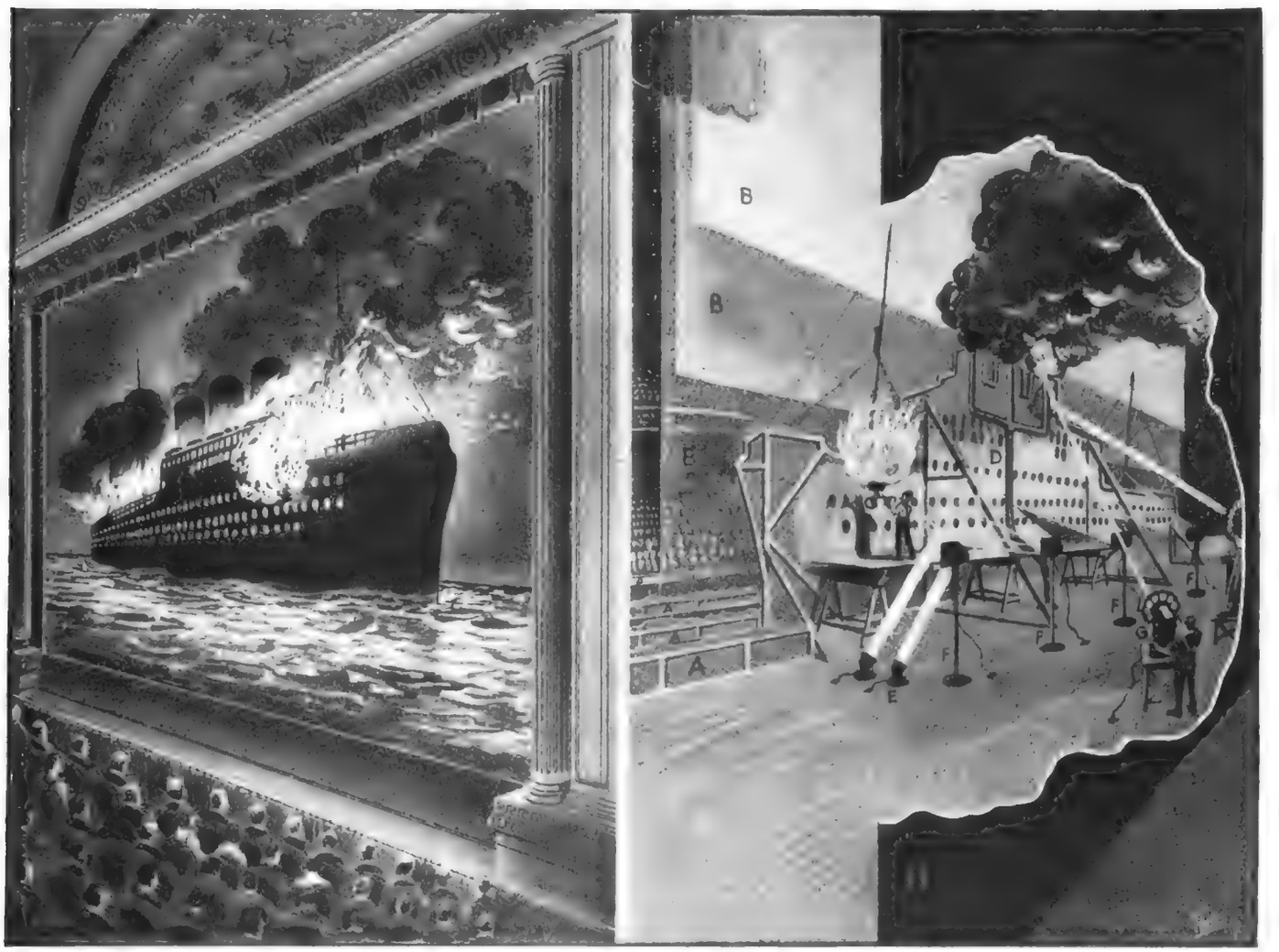
"Burning Ship" Stage Scene

A PRODUCTION has been put on the stage of the Chatelet Theatre (France), well adapted to please old and young. The author is M. Mouezy-Eon, who already has given us the play of *Malikoko*. Here there are no puerile fairy divertisements, but ballets of great numbers, alternating with other attractions, such as bombardments in Mexico, the falling of walls, and pursuit of the enemy across mined bridges, which blow up at the opportune moment, and the apparition of an ocean liner on fire. The carrying out of the startling drama of the sea is realized on this immense stage, thanks to the personal care of the manager of the Chatelet Theatre, M. Fontanes, with an astonishing display of stage-craft skill. Our two pictures show, one the scene as it appears to the spectators, and the other, its production witnessed from behind the scenes. It is probable that never before has so simple, and at once so ingenious and spectacular a production been produced, with so impressive an effect upon the stage of a theatre.

In the diagram-picture we illustrate: 1.—The impressive tableaux of *The Marseille* in the Chatelet Theatre. The burning of a liner in the open ocean seen from the auditorium. 2.—Behind the scenes. How the conflagration of the liner was carried out on the stage of the Chatelet Theatre. A lines of water. B, tulle curtains raised in succession, one after the other. They show little by little the ship dimly as if through a fog, which is slowly dissolving away. C, a lycopodium tube producing flames. D, letting red smoke escape in the line of projection of the spotlights, E, F, white reflectors. G, rotating red projections producing the effect of a furnace in a breach through the hull. H, back scenes represent the horizon.

American theatre productions have from time to time boasted of burning ship scenes, and some of these have been very realistic indeed. We remember in one of these scenes a few years ago, where the first part of the ship showed a close-up of the deck, with smoke at first oozing through the cracks under the deck hatch covers and up a companionway. The passengers were ordered on deck, and the crew manned the life boats. The smoke became heavier and heavier, and the curtain rose and fell several times on the scene, while flames began to spout up the companionways. These flame effects are usually produced of course without any actual fire, as this would endanger the scenery. Thanks to the clever artifices of the stage electrician and stage carpenter, a few bits of red silk and some red lights, placed at the base of the silk streamers, and an electric fan, give most realistic flame effects for such stage scenes.

The second phase of the American *burning ship* scene we have in mind at present, showed the ship quite a distance away in the open sea, with the flames mounting up to the mast heads, the model of the ship having been about six feet long in this scene. The red lights shining through the port holes heightened the effect, the same as in the French scene here described. In the American stage scene, the effect of a gradual increasing fog was cleverly reproduced by slowly lowering successive curtains of thin gauze. The finale of this part of the play came with the curtain dropping on the scene showing the burning ship in the distance; when it raised again the ship had disappeared beneath the waves, while close up in the foreground was a life boat with the survivors in it, the boat rocking violently, and the fog thickening fast. Moving wave effects were projected on strips of canvas, placed in front of the boat, so that it was difficult to tell whether or not the boat was being rowed through real water or not.



The Impressive Tableaux of "the Marseille" in the Chatelet Theatre. The Burning of a Liner in the Open Ocean as Seen from the Auditorium. Scene at Right—Behind the Scenes. How the Conflagration of the Liner Was Carried Out on the Stage of the Chatelet Theatre. A, Scenic Lines of Water. B, Tulle Curtains Raised in Succession, One After the Other. They Show Little by Little the Ship Dimly as if Through a Fog, Which is Slowly Dissolving Away. C, A Lycopodium Tube Producing Flames. D, Letting Red Smoke Escape in the Line of Projection of the Spot Lights E. F, White Reflectors. G, Rotating Red Projections Producing the Effect of a Furnace in a Breach Through the Hull. H, Back Scenes Represent the H

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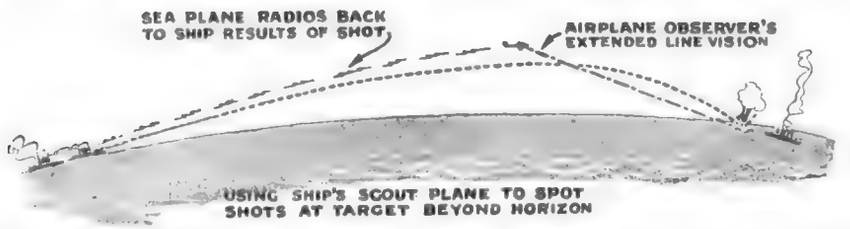
My Visit To A Modern Battleship

By H. WINFIELD SECOR

ASSOCIATE MEMBER, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

THE mystery of the seas has no doubt charmed the minds of boys and young men in every generation, as history shows us, and the writer is no exception to the rule. He has always liked ships whether large or small, but he always had a particular hankering for naval ships. There is a peculiar fascination about a warship, whether it be a dreadnaught, destroyer or submarine, that is hard to define or analyze, but be that as it may, when you receive an invitation to visit one of our modern war vessels, you will lose no time in taking advantage of the invitation, if you possess the average man's love of the sea.


SEA PLANE RADIOS BACK TO SHIP RESULTS OF SHOT
AIRPLANE OBSERVER'S EXTENDED LINE VISION
USING SHIP'S SCOUT PLANE TO SPOT SHOTS AT TARGET BEYOND HORIZON

At the Annual Battle Maneuvers in Which the Atlantic and Pacific Fleets Are Now Participating Off Panama, the Use of Spotting Planes Will Be Carried Into Practice, for the Purpose of Reporting Back to the Ships the Results of Shots Fired on a Target Beyond the Horizon.

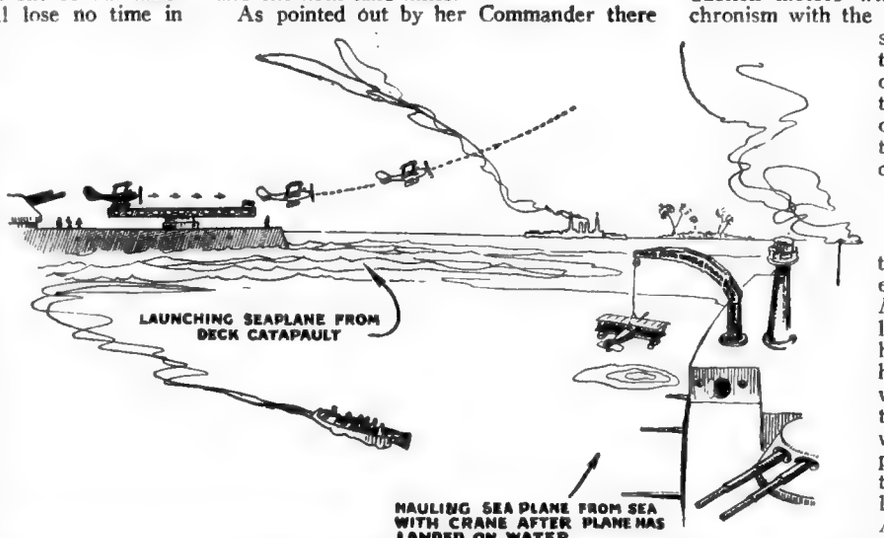
The U. S. S. *Maryland*, flagship of our fleets, represents possibly the highest engineering development in modern fighting ships, and just before she left for the winter battle maneuvers off Panama, the writer had the extreme pleasure of meeting the commander-in-chief of all our forces afloat, Admiral Hilary P. Jones, his staff and the ship's officers. It was indeed a revelation even to the engineers in the party, as they were escorted about the ship on an inspection trip and shown the many wonderful electrical and mechanical devices which had been quietly and efficiently developed and installed on this mistress of the seas.

The U. S. S. *Maryland* is the newest American super-dreadnaught, and represents one of the finest organizations of fighting machinery ever brought together in a single hull. Not an ounce of coal is used on the *Maryland*, the boilers being fired by oil carried in the double bottoms, between the bulkheads, and in auxiliary fuel oil tanks. She can cruise for ten thousand miles without refueling, that is, she could sail from New York to Rio de Janeiro and back without touching the shore.

This giant sea fighter measures 624 feet in length, with a breadth of 97½ feet, and has a specified normal displacement of 32,600 tons, but as one of the officers pointed out, when fully loaded for the southward trip to the battle maneuvers, she would have a displacement of nearly 38,000 tons.

The electric drive has been wonderfully worked out and applied on the *Maryland*, and the electric current necessary for operating the four 7,000 horse-power induction motors rigidly fastened on the ends of the four propeller shafts, as shown in one of the accompanying drawings, are supplied with the necessary two phase alternating current, from either one or both steam turbine generators. Each of these turbo-generators has a rating of 11,000 K. W. at a speed of 2080 R. P. M. Each turbo-generator operating the electric motors connected to the propeller shafts can propel this huge war vessel at seventeen knots. For average speeds, but one turbo-generator is operated. The top speed for this great dreadnaught carrying eight gigantic 16" guns, is 21.7 knots, but in a pinch she might do about twenty-four knots, a knot being about one and one-fifth land miles.

As pointed out by her Commander there is practically no vibration experienced when the ship is moving even at high speed, and in some cases it has become necessary to look out of a port hole to see if the ship was moving or not, so smoothly do the turbines and electric drive propel the huge steel war vessel through the water.

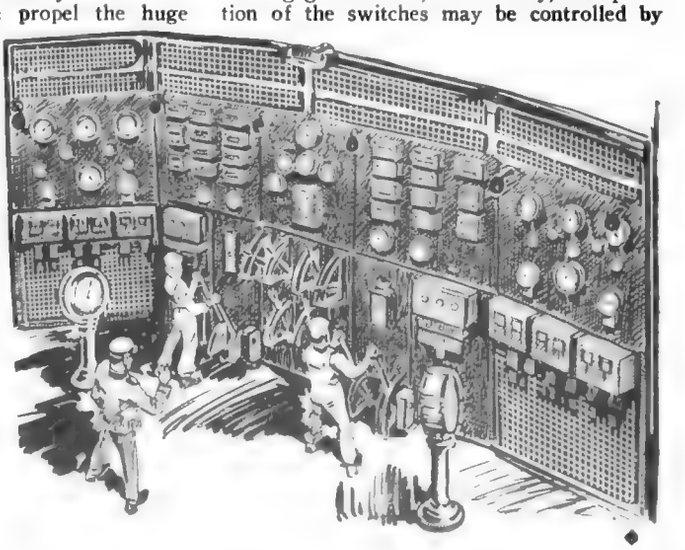


The Sea Plane is Launched from a Ship by Means of a Catapult, Which Shoots It Into the Air Against the Wind at a Speed of Fifty Miles an Hour, While a Giant Electric Crane Hoists the Plane from the Water After Landing.

One of the principal troubles experienced with the older type of reciprocating engine used for propelling ships for many years, is the racing of the screws on the propeller shafts whenever the stern of the ship happened to lift out of the water, the friction and the resistance of the water on the screws being thus momentarily eliminated. The electric drive as applied on the *Maryland*, functions beautifully in this respect, thanks particularly, as pointed out by Commander Van Auken, her Engineer Officer, to the wonderfully designed steam governors on the turbines, which maintain the turbine speed within a few per cent, even with quick changes in load. Speed changes of the ship itself are effected by manipulating switches which change the arrangement of pole connections in the induction type driving motors, or also by electric control of the main steam throttles feeding the turbines, which causes the speed of the turbines to be reduced; this in turn causes the frequency of the alternating current from the turbo-generators to lower, and as is well known, induction motors will tend to keep in synchronism with the frequency of the current supplied them. There are two principal groupings of the poles on the induction motors provided to operate for speeds of sixteen knots and twenty-one knots.

CENTRALIZED ELECTRIC CONTROL

No doubt the most interesting feature of the electric drive on the *Maryland* to land-lubbers like ourselves, is just how far the engineers have simplified matters with regard to controlling this huge power plant, which has a sufficient output in kilowatts to drive the motors and light the lights of a good sized American city like Paterson or Trenton, N. J. Briefly, the main electric control of this huge battleship is centered in two positions, that is, the officers in command can run the ship ahead or astern or bring it to a stop directly from the navigator's bridge high above the water line and big gun turrets; or secondly, the operation of the switches may be controlled by



A View Far Down in the Hold of a Great Modern Warship of the Electric Driven Type, Such as the U. S. S. "Maryland." The Navigating Officer on the Bridge Can Give His Orders by Loud-Speaking Telephone, Regular Telephone, or Else by Means of the Engine Telegraphs, the Dials and Pedestals of Which Are Seen at Either Side of the Operators. A Commissioned Officer is Always on Duty Together with Two Engineer Officers, Who Manipulate the Levers, Which Operate the Large Electric Switches Behind the Switchboard, Which Control the Current to the Four Electric Motors Driving the Ship's Propellers.

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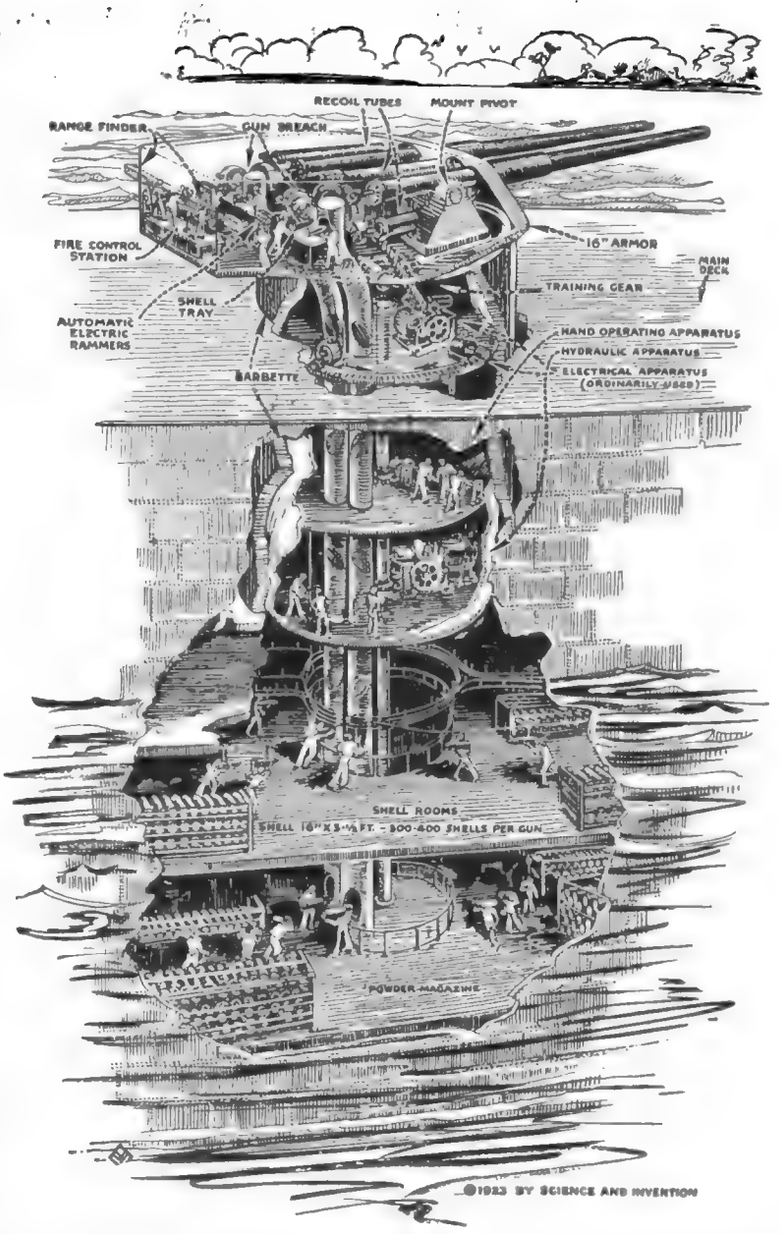
the engineer personnel on duty in the control room before the main switchboard, and following orders as indicated on the engine room telegraph dials, as transmitted electrically from the bridge by the navigation officer on duty.

No doubt you will imagine that when the orders change for *more speed,* or from *ahead* to *astern,* the electricians or engineers in charge of the switchboard will rush about wildly operating a number of heavy switches, but the engineers who designed this control plant have simplified it to the point that it very much resembles the control plan of an average automobile.

As one of our sketches shows, there are three men on duty before the main control switchboard when the ship is under way. Two of these men are engineer warrant officers, while the third is a commissioned officer holding the rank of Lieutenant-Commander or a higher rating. The ranking officer checks the operations carried out by the two men standing at the main control levers, and also the orders, as indicated from minute to minute on the engine room telegraph dials. The observing officer also keeps an eye on the several dozen meters placed on the switchboard, and which show at all times the speed and revolutions of each propeller, the current, voltage and power factor of each motor, the condition and pressure of the oil and also the air pressure itself in the boiler rooms, and a myriad of other things, which space forbids us to describe here. Two engineers shift the levers which we see in the picture, from the center neutral position to the forward position, if the order comes to go *ahead;* while when the order to go *astern* or *backward* is indicated, the two operators on duty pull the levers to the neutral position and then rearward. It will make the picture clearer for the reader if he will imagine for the moment that each one of the four levers corresponds to one of the four propeller driving motors. Picture further in your mind that each set of two levers at right and left, control the two motors on the right and the two on the left.

Now we are ready for the next step. Suppose the order comes to turn to the right or left; if the ship is to be turned to the right quickly, this can be aided by shutting off or reversing the two motors on the right and operating the motors *ahead* on the left. This action aided by turning the rudder, will turn the ship quickly. On long turns this action is not so necessary of course, the rudder taking care of the turning.

The engineer officer who explained the different machines to the visitors, asked how the ship could be propelled if all of the four electric motors should burn out,



First Comprehensive Picture Showing one of the Great 16 Gun Turrets in Action. The Illustration Herewith Shows the Various Decks with the Powder and Shell Magazine Rooms in the Lower Hold Well Below the Waterline, to Give the Maximum Protection Against a Shell Reaching These Vital Parts of a Ship and Causing a Disastrous Explosion, as Happened More Than Once in the World War. The Action Here Pictured is Just at the Moment When the Unburnt Gases Have Been Blown Out of Guns by Compressed Air, and the Huge Shells Weighing About a Ton a-piece, Are Just About to be Placed in the Open Breeches of the Guns. The Ammunition Hoists are Clearly Shown with the Several Automatic Cut-off Doors Placed Along Them to Prevent an Enemy Shell Reaching the Magazines.

replied that this had never caused any worry among naval men, as the motors as well as dynamos were so well built and thoroughly insulated with the best mica and other high grade insulating materials, that the vessels fitted with electric drive to date have not been incapacitated from such troubles, except in one instance, and then the trouble was not due to an electrical fault, but instead to a mechanical one.

The shaft horse-power rating of the U. S. S. *Maryland,* according to the specifications, are 28,000 H.P. developed from her two steam turbo-generators, rated at 11,000 K.W. but in an emergency she has developed between 30,000 and 40,000 H.P. It is interesting to note at this point that on the trip north from Brazil sometime ago, through an eighty-five mile an hour gale, that the roll of the ship was only about seven degrees. Commander Van Auken, when asked what change in horse-power occurred when the stern of the boat raised sufficiently out of the water to remove the friction or load from the propellers, said that in a few moments the meters on the switchboard indicated the remarkable change in load of as high as 12,000 to 15,000 H.P. This terrific shifting or change in load in a short time was smoothly compensated for without racing of the propeller shaft, thanks to the wonderful design of the steam turbine governor mechanism, and also due in great part to the remarkable flexibility and inherent stabilizing qualities of the electric dynamo and motor driving system. Each of the four induction type driving motors measure twelve feet in diameter, and at top speed turn the propeller shafts at one hundred and seventy R. P. M. Besides the two main turbo-generators which supply electrical energy only for the four propeller driving motors, there are six three hundred K.W. steam turbo-generators for supply-

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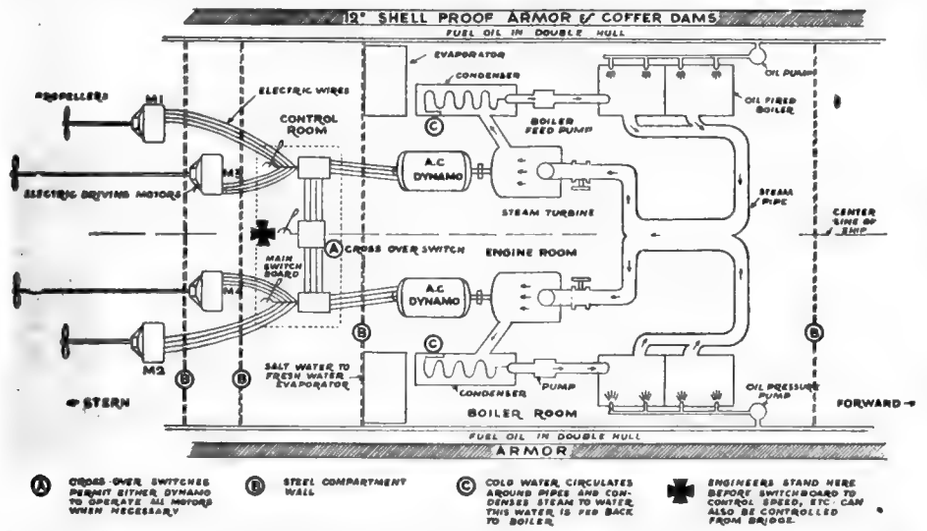

Schematic Plan View of the Electric Drive on the Battleship "Maryland," Showing the Steam Lines and Electric Circuits. This Vital Part of the Ship is Protected Overhead from Airplane Bombs or High Angle Shell Fire, by 4-Inch Steel Armor Placed Over These Quarters.

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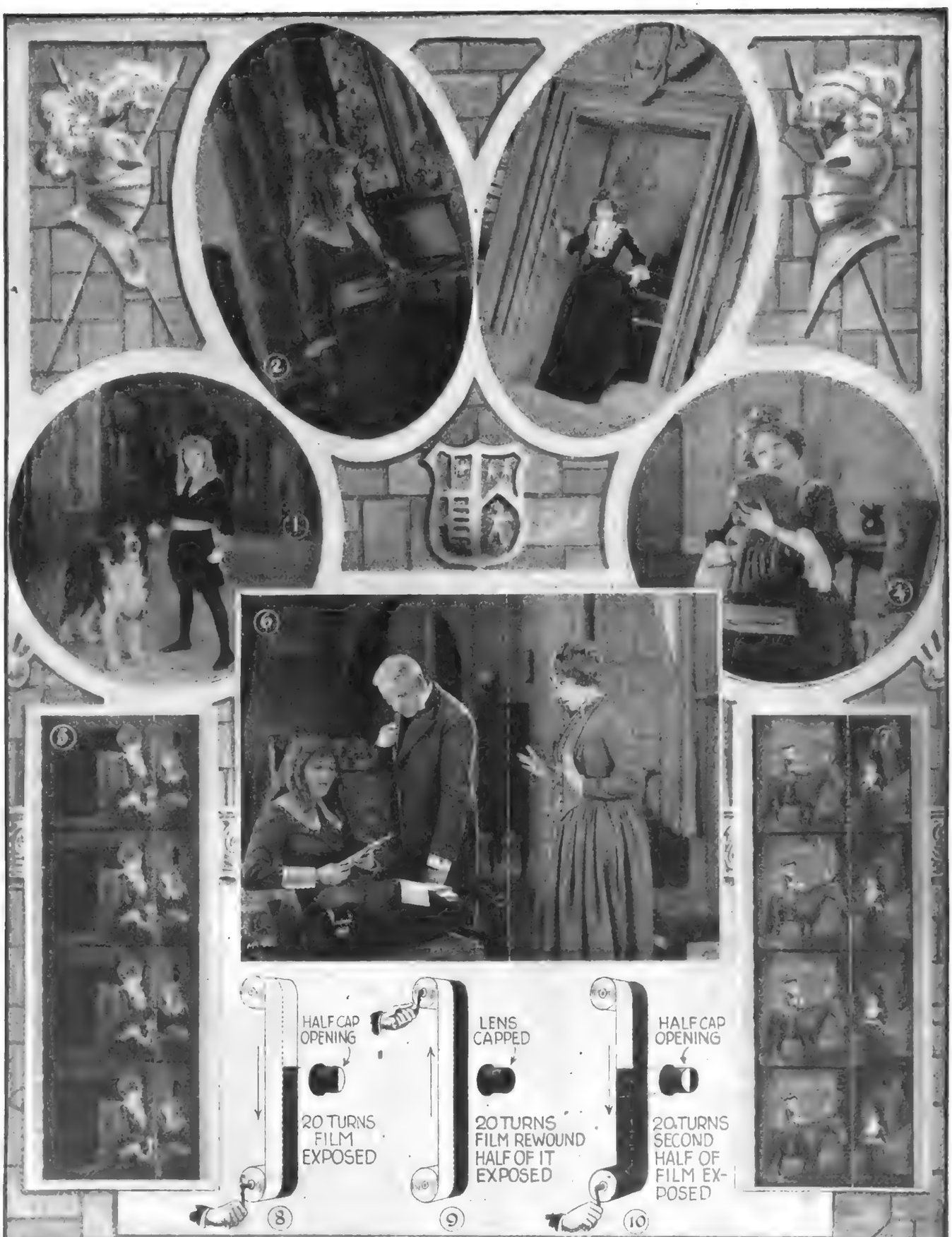
Mary Pickford In Dual Film Role

HALF CAP OPENING
20 TURNS FILM EXPOSED
LENS CAPPED
20 TURNS FILM REWOUND HALF OF IT EXPOSED
HALF CAP OPENING
20 TURNS SECOND HALF OF FILM EXPOSED

1—Mary Pickford Wears Shoes Without Heels, and As Far As Possible Keeps a Little In the Background So That Distance Will Reduce Her Height. 2—A Close-Up of the Actress In Her English Dress. 3—On This Film Mary Pickford Takes Two Characters. As the Mother, She Wears Special High Heeled Shoes. 4—Here Mary Pickford, the Mother, Is Shown Embracing Little Lord Fauntleroy, a Dummy Figure In This Instance. 5—A Bit of the Double Exposed Film (Dotted Line Separates Two Exposures). 6—Here Again We Have Miss Pickford In Two Characters. 7—Here the Little Lord Is Riding His Pony and His Mother Watches Him. The Effect In These Films Are Produced By Exposing One-Half of the Width of the Film At a Time, As Described Below. 8—First Operation. Twenty Turns of the Handle Have Been Given. Upper Reel Carries the Unexposed Film; the Objective and Its Mica Screen Cut Off One-Half Its Surface. 9—Second Operation. The Film Is Re-Wound Upon the Upper Reel. 10—Third Operation. Twenty Turns of the Crank Are Again Given On the Lower Reel. The Latter Receives the Film, Both of Whose Lateral Halves Have Now Been Exposed

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Some Interesting Sidelights on the Question of the Day as to Which Is the Best and Most Harmless to Smoke—Pipe, Cigar or Cigarette, Are Here Given by Mr. Ginsberg, Well-Known Chemical Expert and Writer. Smoking is a Habit Which Has Been Equally Condemned and Approved by Various Experts, and From General Observation it Would Seem that if a Man Smokes in Moderation, and Providing He Has the Average Strength of Heart and Condition of Nerves, that Smoking Will Not Do Any Noticeable Harm. Inhaling of Cigarette Smoke is One of the Most Dangerous Habits, As a Greater Quantity of Nicotine is Caused to Affect the System. It is a Bad Habit for Boys and Young Men to Acquire as it Has Been Proved That Smoking, Even But One Cigarette, Slows up the Speed of Thought and the Ability to Concentrate.

Pipe, Cigar or Cigarette Which?

By ISMAR GINSBERG, B. Sc. Chem. Eng.

NICOTINE is an alkaloid. Alkaloids are organic compounds, containing the element nitrogen, and often possessing great physiological action. Morphine, cocaine, strychnine, heroin are alkaloids and they are all extremely powerful in their action on the nervous system of the body. These substances are all violent poisons, but in small quantities they are very important medicaments. Nicotine is likewise a deadly poison; in fact it is claimed that its poisonous effects are as powerful as those of hydrocyanic acid, commonly called prussic acid. In small quantities it has a similar effect to that of the other alkaloids.

The "kick" in tobacco is nicotine. The commonly alleged nerve soothing effects, which are produced by the smoking of tobacco, are due primarily to it, and it is safe to say that tobacco without nicotine would be as stimulating as beer without alcohol. Inasmuch as nicotine is such a deadly poison, it may be interesting to know just how much nicotine there is in tobacco, what happens to it when the tobacco is smoked, and whether there is any difference to be noted in the smoke from a cigar, cigarette or pipe.

The first important consideration is how much nicotine does the tobacco contain. As is known, tobacco is primarily American product. The Indians used it prior to the discovery of the New World, and it was not long thereafter that it found its way into Europe and the other continents. The tobacco plant is peculiar in its ability to adapt itself to the climatic conditions and soil conditions of the place in which it is grown, and in time to develop a species, which is characteristic of the locality, This is the reason why there are so many different grades of tobacco, and in fact so many variations in one particular grade. Moreover there are actually about forty varieties of the tobacco plant itself and though originally of American origin, the tobacco plants, that have become acclimated to the soil and climate of Turkey, Egypt, Java, or Sumatra, produce tobaccos, each one possessing its own peculiar properties, quite different from tobaccos grown in other lands. In fact there are but few plants known that are so susceptible to soil, feeding and culture as tobacco.

This characteristic of the tobacco plant has a great effect on the amount of nicotine in the leaf as well as on the other properties of the plant. The combustibility of the weed, that is, the ease with which it burns, for example, can be controlled very largely by the selection of the proper kind of fertilizers, those containing little potash, magnesia and lime. The nicotine in tobacco is similarly affected and during the entire growth of the plant the percentage of nicotine is constantly varying, reaching a maximum percentage at full growth. Besides the type of plant itself and the conditions under which it is grown, that is whether grown in the shade or in the sun, the treatment of the crops, etc., the most important factors, determining the proportion of nicotine in the tobacco, are the nature of the soil and the fertilizers.

Inasmuch as nicotine contains nitrogen, it is evident that a tobacco, grown in a rich, heavy soil, fertilized with a strong nitrogenous fertilizer, will probably contain a higher percentage of nicotine than a tobacco, grown in a light, sandy soil containing little organic matter. Havana tobacco is grown in the latter type of soil and consequently it does not contain a high percentage of nicotine. The quality of the tobacco is not determined by its high content of nicotine, but the case is quite the contrary. It has been found that tobacco, which contains a high percentage of nicotine, is apt to be coarse and of relatively poor quality. Some of the finest Havana tobaccos contain less than one per cent of nicotine.

The treatment that the tobacco receives after it has been taken from the fields also has a great influence on the percentage of nicotine contained in it. In general green tobacco is richer in nicotine than cured tobacco. The tobacco is first cured, which consists in drying it, either by the natural action of air and sunlight or by artificial heat. Sometimes it is dried by means of open fires of sassafras and hickory wood.

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The Thing from—Outside

By GEORGE ALLAN ENGLAND

THEY sat about their camp-fire, that little party of Americans retreating southward from Hudson Bay before the on-coming menace of the great cold. Sat there, stolid under the awe of the North, under the uneasiness that the day's trek had laid upon their souls. The three men smoked. The two women huddled close to each other. Fireglow picked their faces from the gloom of night among the dwarf firs. A splashing murmur told of the Albany River's haste to escape from the wilderness, and reach the Bay.

"I don't see what there was in a mere circular print on a rock-ledge to make our guides desert," said Professor Thorburn. His voice was as dry as his whole personality. "Most extraordinary!"

"*They* knew what it was, all right," answered Jandron, geologist of the party. "So do I." He rubbed his cropped mustache. His eyes glinted grayly. "I've seen 'prints [illegible] before. That was on the Labrador. And I've seen things happen, where they were."

"Something surely happened to our guides, before they'd got a mile into the bush," put in the Professor's wife; while Vivian, her sister, gazed into the fire that revealed her as a beauty, not to be spoiled even by a tam and a rough-knit sweater. "Men don't shoot wildly, and scream like that, unless—"

"They're all three dead now, anyhow," put in Jandron. "So *they're* out of harm's way. While we—well, we're two hundred and fifty wicked miles from the C. P. R. rails."

"Forget it, Jandy!" said Marr, the journalist. "We're just suffering from an attack of nerves, that's all. Give me a fill of 'baccy. Thanks. We'll all be better in the morning. Ho-hum! Now, speaking of spooks and such—"

He launched into an account of how he had once exposed a fraudulent spiritualist, thus proving—to his own satisfaction—that

HERE is an extraordinary story by the well-known magazine writer, George Allan England. This story should be read quite carefully, and it is necessary to use one's imagination in reading it.

The theme of Mr. England's story is unusual and extraordinary. If we can take insects and put them upon the dissecting table in order to study their anatomy, is there a good reason why some super-Intelligence cannot do the same thing with us humans?

It may be taken as a certainty that Intelligence, as we understand it, is not only of our earth. It is also not necessary to presume that Intelligence may have its setting only in a body of flesh and blood.

There is no reason for disbelieving that a Super-Intelligence might not reside in gases or invisible structures, which we of today cannot even imagine.

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". . . . Out of the door crept something like a man. A queer, broken, bent-over thing; a thing crippled, shrunken and flabby, that whined. This thing—yes, it was still Marr—crouched down at one side, quivering, whimpering. It moved its hands as a crushed ant moves its antennae: jerkily, without significance. . . ."

nothing existed beyond the scope of mankind's everyday life. But nobody gave him much heed. And silence fell upn the little night-encampment in the wilds; a silence that was ominous.

Pale, cold stars watched down from spaces infinitely far beyond man's trivial world.

Next day, stopping for chow on a ledge miles up-stream, Jandron discovered another of the prints. He cautiously summoned the other two men. They examined the print, while the women-folk were busy by the fire. A harmless thing the markings seemed; only a ring about four inches in diameter, a kind of cup-shaped depression with a raised center. A sort of glaze coated it, as if the granite had been fused by heat.

Jandron knelt, a well-knit figure in bright mackinaw and canvas leggings, and with a shaking finger explored the smooth curve of the print in the rock. His brows contracted as he studied it.

"We'd better get along out of this as quick as we can," said he in an unnatural voice. "You've got your wife to protect, Thorburn, and I—well, I've got Vivian. And—"

"*You* have?" nipped in Marr. The light of an evil jealousy gleamed in his heavy-lidded look. "What you need is an alienist."

"Really, Jandron," the Professor admonished, "you mustn't let your imagination run away with you."

"I suppose it's imagination that keeps this print cold!" the geologist retorted. His breath made faint, swirling coils of vapor above it.

"Nothing but a pot-hole," judged Thorburn, bending his spare, angular body to examine the print. The Professor's vitality all seemed centered in his big-bulged skull that sheltered a marvellous thinking-machine. Now he put his lean hand to the base of his brain, rubbing the back of his head as if it ached. Then, under what seemed some powerful compulsion, he ran his bony finger around the print in the rock.

"By Jove, but it *is* cold!" he admitted. "And looks as if it had been stamped right out of the stone. Extraordinary!"

"Dissolved out, you mean," corrected the geologist. "By cold."

The journalist laughed mockingly.

"Wait till I write this up!" he sneered. "'Noted Geologist Declares Frigid Ghost Dissolves Granite!'"

Jandron ignored him. He fetched a little water from the river and poured it into the print.

"Ice!" ejaculated the Professor. "Solid ice!"

"Frozen in a second," added Jandron, while Marr frankly stared. "And it'll never melt, either. I tell you, I've seen some of these rings before; and every time, horrible things have happened. Incredible things! Something burned this ring out of the stone—burned it out with the cold of interstellar space. Something that can impart cold as a permanent quality of matter. Something that can kill matter, and totally remove it."

"Of course that's all sheer poppycock," the journalist tried to laugh, but his brain felt numb.

(*Continued on Page 1223 on Page*

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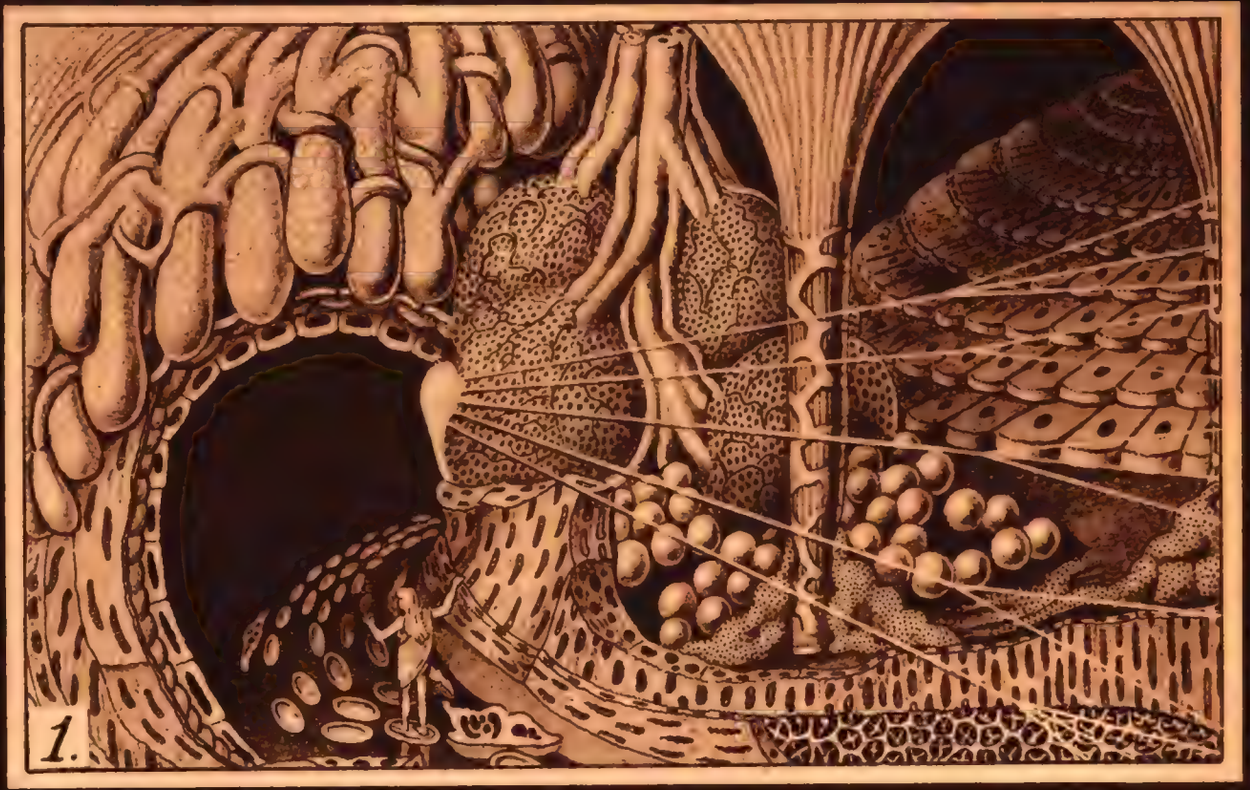
JOURNEY ON A CORPUSCLE



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A Journey on a Corpuscle

WE are poets, and in our kingdom of fantasy every wish is fulfilled. Scarce have we formed a thought, when, like the hero in the old fables, we get smaller and smaller until we finally are of microscopic size, and as micro-Lilliputians stand upon the border of the stream of a human Vein, and the cells, for us as large as real boats, drive past us. We stand on one of the cliffs which project into the stream, and wait. Cell after cell swims past us, but rapidly and in the middle of the stream, unattainable by any efforts of ours.

Finally a little corpuscle boat comes near us on the shore, and lies there like a skiff at our service. We jump into it, and it rocks from left to right. We push it out and off we go, in the corpuscle boat, on the golden-red stream of blood. Goodbye, kingdom of humanity! We are in fairyland, in the fairyland of truth, over which you great giants stamp with your huge unsuspicious feet and tread upon true wonders as you progress.

The channel, which is small, is called a capillary vein, whose finest ramifications can only permit a single cell to pass, just as in the side canals of Venice only a small gondola can make its way between the straight walls of the palaces. The blood streams slowly through the little tube, and we use this slow progress to look upon the landscape around us with the eyes of a micro-Lilliputian.

This world is truly wonderful, through which we travel. Not so different from the world of humanity as one might suppose. We find the same forms as in the world of the great mountains, rivers, and woods above us, and similar forms are part of the present landscape. As the stream flows along on which we float, upon the right and left the shores arise, sometimes flat, like meadow land, sometimes steep, like cliffs, and behind them hills ascend, level places stretch out, heaped up masses of globules of fat cells form assemblies of cells resembling houses and in the distance glands resembling gasometers rise against the dark horizon.

Fibres and filaments form hedges around gardens and yards of cells, form courses through which wandering cells move in certain fine paths marking their course, and a great nerve ganglia, like a long distance central station, sends out on all sides its electric cable, and all this lies still and clear and glassy there, as if the world was frozen into ice, as if a kingdom of salt and rock crystal rose up from the depths of an enchanted mountain. It is a world of plasma —it is glassy, shimmering, amber-colored, living material, out of which the bodies of human beings are made.

We make a turn and the picture changes. Now we are at the entrance of a gland (Fig. 1). As at the entrance of the famous Fingal's Cave, here is a gigantic door, made of hundreds of columns that start up out of the red river, like a portal, and disappear above. Clusters of glands, encircled by serpent-like veins, hang down in profusion and give a picturesque frame to the arch. Near the door of the globules stands a fantastic monument. On a columnar base rises a great fluted pillar rising out of its many roots, into the apparent infinity above. A lymphatic gland which acts as toll station for the progress of the fluids through the grotto-like entrance, watches over the flow. In the background rises a broad terrace of flat plate-shaped cells. This is the Epithelium, the cover fabric which is drawn over the glands on their upper surfaces, and to the eye of a micro-Lilliputian, seems so gaily and beautifully adorned, that it would occasion no surprise if a procession of priests and pilgrims would step down the boundary steps of the great temple, while a supernatural music would follow their steps through the portals.

On the border of the current of the Vein is this binding fabric, as it were, of trees. There rise up tree-like forms which carry the walls of the landscape, spread out at the tops like palm trees, like to the pillars of a gothic cathedral, or like Atlas, with their wide-stretched arches supporting the firmament of the micro-cosmos of the cells. Brown surfaced cells lie at their feet, cells of pigment and fat, which are the sources of color and nourishment for the cell industry, and from tree to tree the telegraph lines of the nerves follow the course of the stream.

In a breath this picture ends. We have gone through the portal, and float along through a dark canal. First we see nothing in the darkness, and gradually our eyes becomes accustomed to the obscurity, and we recognize the structure of the thick wall of the Vein, which cuts us off from the outer world. It is built up of long rectanglular, flat cells, which are not joined together with cement, like the stones of the human-built walls, but are only loosely held together so that the fluid of the blood finds its way through between the joints and thus maintains an exchange of material between outer and inner regions. The stream gets wider, the number of flat cells increases, and the corpuscle boats travel, driven by the current through the center, in closer order, striking each other here and there in an ever-quickening course. At the border of the stream the wandering corpuscles travel more slowly, sometimes rolled about, some are like hedgehogs, with many star-like radiations. For these wonderful cells have a power above all other elements of the body, that of changing their form and changing their place as they wander along. They stretch out little feet, hold themselves with these feet strongly to the shores, and creep up out of the stream, over the walls of the tunnel, and, incredible as it may seem, force themselves through the narrow openings of the cells, so as to pass through to the other side. Right in front of us we see such a strange companionship in the wall-like sides, Fig. 2.

Like a polyp it climbs up with outstretched arms on the wall, suspiciously testing, the cells with its fingers as if it suspected danger. Now it manages to get a feeler between the joints of two cells, and reaches through to the further side, forces new portions of its body through, so that the finger swells up into an arm on the other side of the membrane, the end grows into a fist, and becomes larger and larger until the body shrinks up on our side and goes through faster and faster. Now it hangs, a strange-looking object, with half of its body within and the other half outside the vein, like a wasp's body divided in two parts.

We change our course, and the scenery of the polyps disappears. We are drawn through a great vein and now behold a theatrical scene. It first chills our heart and then fills us with pious inspiration. We rise into a suction vein, drawn along by the pumping power of the heart, out of the depths of the body. The tube is wider than before, and the number of corpuscles have increased ten times, yes even one hundred times in number. In order that the blood in its rising out of the depths into the chambers of the heart shall not go back, an automatic mechanism, in the nature of a check valve, closes the veins.

We feel that we are rising, Fig. 3, and then look out upon the surroundings. But woe! the way is closed; as in an empty elevator, which with undiminished speed, threatens to strike against the roof of the house and excites in the dwellers the greatest anxiety, we are drawn up against the dark wall, which closes the canal. Nearer and nearer we come. We strike it, certain of impending death, and feel ourselves in our imagination, beaten against the dark roof. Then it opens, as if drawn by the miracle of an invisible hand, the membrane flies to one side and we rise up near the wall over its edge and see now under us a crescent-shaped valve in the wall of the vein, hanging down like a swallow's nest. We breathe freely again, but hardly escape, when again danger threatens us. The current ceases, we stand still and begin to drift backwards. A fathomless depth again yawns beneath us. On we go, and we are drawn along by the invisible power of the spiritual onwards again, again towards a membraneous curtain. Again we think that we shall be beaten to pieces, again the membrane opens at the very last instant, and we go through the dark wall. We see the membrane fall behind us. We are again imprisoned. We are again drawn along, once more raised up, and so we rise up as in a continuously running elevator through valve after valve in the heart. Fig. 4.

On all sides new streams of dark blood stream towards us. On every branch new corpuscles float past us so that the stream is filled to the brim. We, too, follow along with the stream. The waves get higher and higher and now the corpuscles beat against each other. They yield. They strike. They leap back and threaten to sink. Full of care, we hold on to the edge of our little craft and look anxiously into the blood.

—*Cosmos.*

May Features in Science and Invention

The Automobile of the Future
By H. Gernsback

Hunting Criminals in 2,000 A.D.
By Felix Leo Goeckeritz

Treating Cancer With X-rays
By Joseph H. Kraus, Staff Medical Expert

How to Photograph Fireworks—With Some Excellent Photos Taken by Author *By Wm. P Sipes*

At the New York Inventors' Show. Illustrating and describing all the latest ideas of our inventors, from patent mustard pots to perpetual motion

Tut-Ankh-Amen—What Science Has Learned About the Early Egyptian Life

Second Article "Magic For Everybody." *By Prof. Dunninger*

Clocks That Wind Themselves
By Ismar Ginsberg

Peace-time Uses for War Gases

Obtaining an Amateur Radio License —With photos and latest revisions of radio law *By A. P. Peck*

A Compact Radiophone Receiving Set, With V.T. Amplifier
By Clyde J. Fitch

Humor in the Patents

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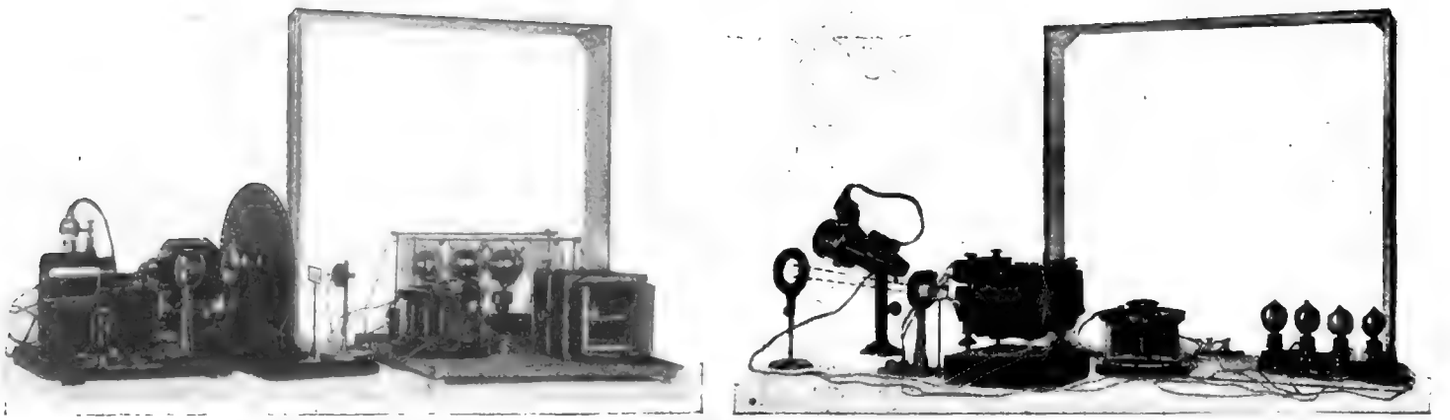


Above Are Two Photographs Showing the Transmitting (Left) and Receiving (Right) Apparatus for the Demonstration of Television. The Transmitter is Composed of a Special Optical Device Combined with a Screen and a Perforated Disc Projecting a Beam of Light Through the Screen Upon a Photo-Electric Cell. The Current of a Radio Telephone Transmitter is Modulated, the Photo-Electric Cell Replacing the Microphone. At the Receiving End, the Current After Being Amplified, Acts Upon an Oscillograph, the Mirror of Which Reflects a Beam of Light Through a Similar Screen to the One Used at the Transmitter and Projects it Upon a Screen.

The Belin Radio-Television Scheme

By ROBERT E. LACOULT

A FEW years ago there were published in this magazine, then the *Electrical Experimenter*, some very interesting articles on *television* in which were described several types of telephotes operating on different principles. Some of them were practical and might have been used were it not for the great number of connections and apparatus required for their functioning. In these articles were described early attempts to transmit the picture of a person over telephone wires so that the person at the distant end of the line could see who was talking to him.

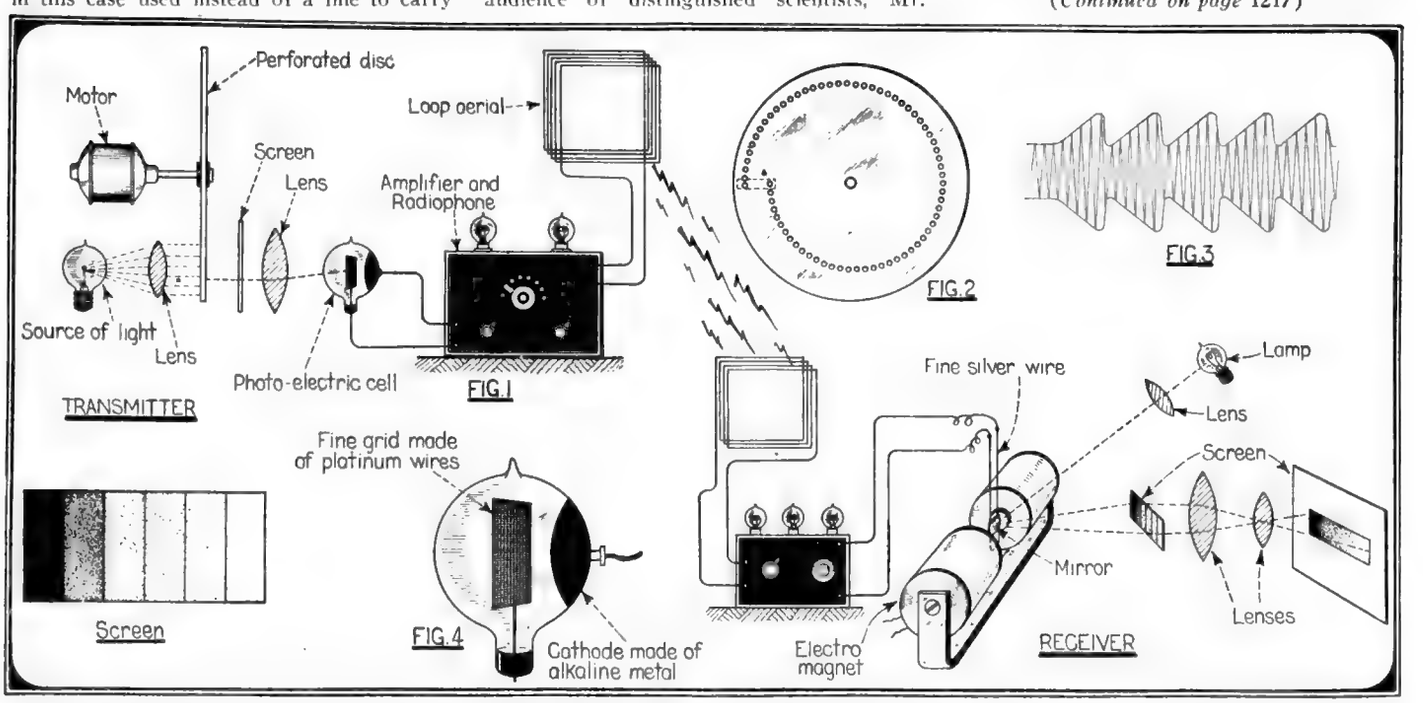
The telephotes could also be used to send moving pictures by radio or wire as the transmission of animated pictures would be done in exactly the same way, a film being sent from the transmitter or a subject placed directly in front of the screen. Undoubtedly, before long we will be able to see by wire and by radio just as easily as we now hear over the telephone. By slight modifications of the whole system, television will be possible by radio, modulated radio waves being in this case used instead of a line to carry to the distant station the electrical impulses impressed upon the transmitter by the subject to be transmitted. This system will make it possible for ships at sea and stations at very remote points to receive animated pictures by radio and to show to an audience the events which are happening in distant cities or in some other country. Several other uses will, of course, suggest themselves as the devices are perfected.

Recently, the well-known French engineer, Mr. E. Belin, famous for his telesterograph, by means of which pictures and documents can be sent by wire or by radio, delivered at the Sorbonne in Paris a lecture on television and demonstrated an experimental apparatus which proved that it was entirely practical to send animated pictures to a distance by wire or by radio. Mr. Belin is actually working on such an apparatus and has obtained very gratifying results; he expects to have his machines completed and to give a demonstration of television before the end of the year.

During the lecture delivered before an audience of distinguished scientists, Mr. Belin used a simplified set to illustrate the principle. Our illustrations show the transmitter and receiver which were installed in the same room, loop aerials being used as the range was so short.

By means of this apparatus, it was possible to transmit by radio, luminous bands varying in tint from black to full white passing through various values of gray which are found in any photograph or moving picture film. The sketch, Fig. 1, shows the arrangement of the instruments. A source of light, 1, composed of a Pointolite lamp, providing an intensly luminous spot of very small area, is placed in front of a lens concentrating the light upon the edge of a disc having drilled near its circumference, a series of small holes following the line of a spiral as shown in Fig, 2. When revolving, this disc allows the light to pass through each hole in turn, thus covering a horizontal strip, as shown by the dotted lines, which corresponds exactly with a small screen colored with all values of grays from black to white. The light passes through

(*Continued on page* 1217)



The Diagram, Fig. 1, Shows How the Transmitter Operates. Fig. 2 Shows How the Disc, Rotated in Front of the Screen, is Perforated so as to Permit a Beam of Light to Cover the Whole Length of the Screen at Every Revolution. Fig. 3 Illustrates Modulation of the Radio Waves Produced by the Radiophone Transmitted Every Time the Ray of Light Passes Through the Screen from Black to White. Fig. 4 is a Detail of the Construction of the Photo-Electric Cell Which Modulates the Oscillating Current of the Radiophone Transmitter. The Diagram of the Receiver Clearly Shows How a Beam of Light Produced by a Lamp and Concentrated Upon the Mirror of the Oscillograph Reproduces Upon a White Screen, the Shaded Screen Which Varies in Colors from Black to White, Passing Through All Grades of Gray Interposed Between.

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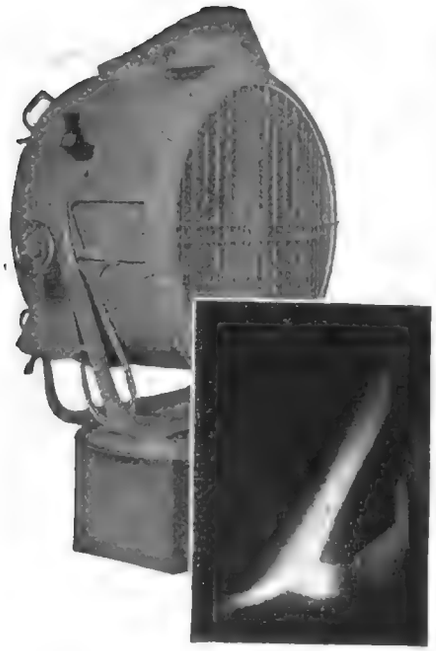

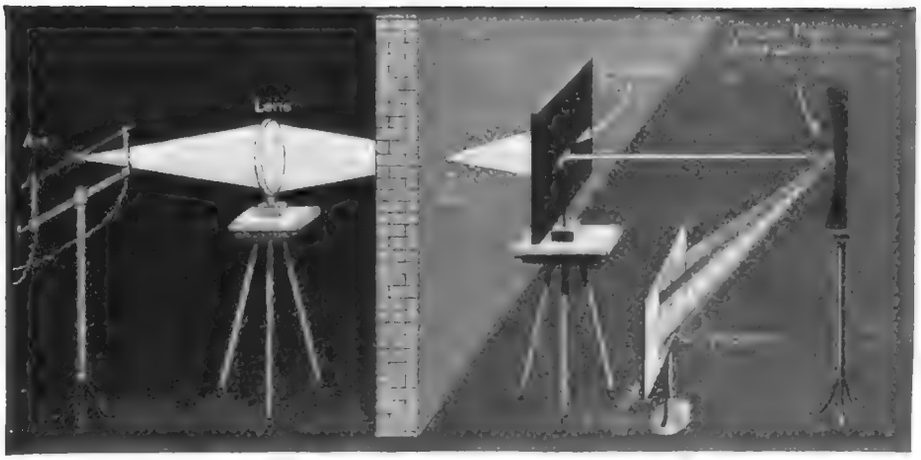

The Apparatus and Its Arrangement for Detecting the Presence of Helium Gas In an Electric Arc Is Shown Above. A Condensing Lens Is Used to Concentrate the Light of the Arc Upon a Hole In the Wall, From Which the Light Goes To a Screen With an Adjustable Slit In Its Surface. A Certain Amount of Light Is Then Allowed To Pass To the Concave Ruled Mirror, From Which It Is Reflected In the Form of a Spectrum To the Screen, Upon Which the Spectrum Is Studied.

Illustration At Left Shows Powerful Sperry Arc Searchlight, Which Requires a Current of 150 Amperes and Yields 500,000,000 Candle-Power. The Smaller Photograph Shows Close-Up View of Sperry High Power Arc With White Tongue At Negative Electrode.

Carbon Transmuted Into Helium

FOR years the problem of tarnsmutation of baser metals to precious metals, has occupied the attention of the alchemists, but has never been solved. A transmutation has however, been effected by Dr. Louis Bell and P. R. Bassett of Brooklyn, N. Y. They have succeeded in obtaining the gas helium, which was first discovered upon the sun, by breaking down the carbon atoms in an arc of terrifically high power.

In a recent interview with Mr. Bassett, he told the writer the story of their discovery as follows: "While experimenting," said Mr. Bassett, "with an electric arc actuated by 150 amperes, a higher amperage than has heretofore been used, Dr. Bell and myself noticed that a faint inner core seemed to be present in the arc which had hitherto never been seen. Of course, our curiosity was aroused, and we proceeded at once to find out just what caused this core, and what it was composed of. Rough tests made with a spectroscope revealed a small number of clearly marked lines super-imposed upon fainter, hazy bands, which were due to the

(*Continued on page* 1234)

A Mechanical Quartermaster

In the photograph herewith we see a close-up view of a mechanical quartermaster, which enables a ship to be steered across the briny deep over any pre-determined course, at any rate of speed, and under any adverse conditions, without departing from that course by even half a degree. This quartermaster is mechanically connected to the steering wheel arbor or shaft by a sprocket chain, a sprocket being secured both to the wheel in the pilot house and also to a motor housed within the casing of the automatic steerer. The chain-drive may be disconnected from the motor by simply shifting the lever. The steering wheel itself may likewise be uncoupled from the telemotor shaft, and if desired, the small auxiliary steering wheel, shown in the illustration, may be employed instead of the regular pilot wheel. Glancing at the top of the automatic steerer we find mounted thereon, a gyro-compass repeater.

Inasmuch as all automatic steering requires a test at sea, the device is not placed in operation until the ship passes out through the inland waters. When all adjustments are then properly made, that is the adjustment for the amount of helm, which should be given for various winds, tides, weather conditions, and characteristics of the ship itself, the vessel will steer a perfectly straight course. At any time operation of the miniature steering wheel will change the course of the vessel, and by simply shifting a lever, the rudder can be thrown to the automatic steering device, to

(*Continued on page* 1237)

Captain Andrew Asborn of the "Munergo," a Trans-Atlantic Liner of the Munson Line, and the Mechanical Steering Device Which Enabled the Steamer To Go From the West Indies To New York Without a Hand Being Placed At the Steering Wheel. He Explained That the Device, Once the Ship Was Set For Its Course, Remains Steady, and If Anything Goes Wrong It Is Made Known By a Grinding Sound, Followed By the Ringing of a Bell.

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Fig. 1. From an Actual Photograph Which is to Be Sent Over the Wires.

Fig. 2. Photograph with Features Outlined and Shadows Divided into Five Degrees of Shade

Fig. 5. This Shows the Shadows Roughly Blocked Out — Poster Effect.

Fig. 6. And This is from the Finished Picture Ready for Publication. Compare 1 with 6.

Telegraphing Pictures by Code

By D. W. Isakson

THE problem of transmitting photographs electrically is a vexatious and a knotty one to which we have had many near solutions, but at last it would seem that we are approaching the desired goal.. In the columns of this magazine we have read some very interesting descriptions of apparatus designed to this end. Among them have been some by the inventor of the process which is to be the subject of the present article. These have all been successful so far as the actual transmission of the picture goes, but economically considered they have not been practical. Though in them we may not see the answer to our elusive problem, they are important factors—the known quantities upon which we may work to an ultimate success.

Until the practical system has been evolved (and Mr. Leishman is certainly a tireless worker) the Leishman concern is furnishing telegraph photo service to many of the progressive newspapers of the United States by a method that is distinctly a departure from anything thus far introduced.

LVGIS	MBGWQ	MJIJQ	MTITQ
QJJBQ	QUJDQ	SDIXQ	SQISQ
TEIBQ	TGGQQ	TMFQQ	TSEUA
TDEKA	SMEUQ	QXEMQ	QJEQQ
MVEQQ	MJEKA	MEEIQ	MDETQ
MBFWQ	LVGIQ	LMGKQ	LIGMQ
KVFWQ	KTFTQ	LDFBQ	LAEWQ
LJEGQ	LQDQQ	LUBWQ	MQAVQ
SAAMQ	SKAMQ	TDAVQ	TLBIQ
TUBTQ	TXBVQ	TVDAA	TXDDQ
UADMQ	UAEIQ	TWELA	UBETQ
TXFFQ	TUFQQ	TVFVQ	TUGAQ
TWGMQ	UAGXQ	TSIGQ	TGIFQ
MQFEE	QFFEQ	QMFIQ	QSFMG
QSFAQ	QBEWA	QAEVA	MMEVQ
QAFDM	QJFDM	MTFFE	QBFFQ
QMFLG	QGFLQ	MXFJQ	MTFFD
QAFIQ	QEFKQ	QGFJQ	QIFGK
QBFIQ	QFFJQ	QFFIQ	QEFFM
QFFGV	QJFIS	QKFKA	QFFLK

Fig. 3. This is Part of the Program or Code Telegraphic Message—the Form in Which the Picture is Flashed Over the Wires.

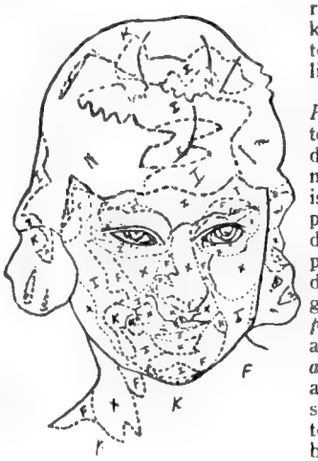

Fig. 4. This is the Complete Outline Obtained from the Code, with Proper Shade Letters Within Enclosures (Right).

In newspaper picture work five gradations of shade, viz.: white, light grey, medium grey, dark grey and black, are all that appear in the finished half-tone. This fact is taken advantage of in the new process and the first step is to divide the subject photograph into areas comprising a single shade. In the telegram these shades are designated by certain letters such as X white, F light grey, I medium grey, K dark grey, M black. With the various degrees of shades thus blocked out the photograph is ready for the coding process. This is done with an apparatus consisting of an ordinary drawing board with a scale at its top marking off abscissas and a T square with a similar scale on its edge marking off the ordinates. The scales are divided into eighteen prime divisions and each prime division into a similar number of sub-divisions. A letter of the alphabet is used to designate each, and since only eighteen are necessary those letters most easily confounded are omitted.

With this board it is possible to accurately locate any point as fixed and described by another board. If points placed along a line bounding a shade be accurately fixed by the operator of the board at the sending station and a record be transmitted to the operator at the receiving station, he will be able by means of his board, to reconstruct that line. Given the letter corresponding to the shade he will know precisely the shade he is to fill in the area enclosed by the line.

The expense of sending the *Photogram*—as the inventor has termed it—must obviously be reduced to a minimum in order to make the venture profitable. It is therefore of the greatest importance that the fewest possible determining points be used. The placing of these, therefore, is done having in mind the two geometrical propositions *that two points determine a straight line* and that *three points determine a circle*. Any straight portion of an outline may therefore be described by, what in code, comes to two words. Any curve can be resolved into area of perfect circles, each of which may be described by words.

In order that the receiving operator may know the nature of the line he is to trace through the points he has located he is given a letter. These letters and their meaning are as follows: S beginning of line, D end of line, A end of straight line, Q cusp, W end of straight dotted line, U cusp dotted. The last two, i. e., dotted lines, indicate also that the shades they divide are to blend.

(*Continued on page* 1241)

Fig. 7. Before Telegraphing: This is from the Original Photograph as it Was Taken at Sing Sing Prison, N. Y., Just After the Fire.

Fig. 8. After Telegraphing: Picture of the Sing Sing Fire, Published by Many Western and Pacific Coast Papers Within Twenty-four Hours of the Fire—Really Before the Fire Was Out

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". . . . Gloria Mundy Took the Glove-Like Contraption Handed to Her, and Drew it on Her Hand. For a Moment She Stood in Expectation, and Then a Look of Wonder and Delight Came Into Her Eyes, and She Felt a Sense of Ecstasy Such as She Had Never Before Experienced in Her Life . . . ."

Dr. Hackensaw's Secrets

By CLEMENT FEZANDIE

(AUTHOR'S NOTE: *Sound waves, light waves and radio waves are all produced by vibrations. But between the slow vibrations of sound and the rapid vibrations of the ultra-red waves perceptible to us as heat, there is a wide gap which we have no means of perceiving. Similarly, between the ultra-violet or actinic waves which affect a photographic plate, and the radio waves of wireless telegraphy, there are still other gaps. At the present day we are able to transform the radio waves into sounds, and it is highly probable that in a few years we shall find means of doing the same for the unknown waves. But we may go even a step further and devise instruments that will give us new senses—in other words, that will enable us to perceive the unknown waves directly, without first changing them into light waves or sound waves.*)

No. 15--The Secret of the Sixth Sense

"AH, Miss Gloria; glad to see you! And how are you, Silas? I see you've brought your fiancée along with you today. Evidently you hope to worm some more of my secrets out of me. Well, you come at just the right time. I have made many inventions, but I think I have today one of the greatest inventions ever made by man. By the way, Miss Gloria, what would you call the greatest invention ever made?"

"I should say . . . er . . . kissing," replied the young lady, with a rosy blush and a sidelong glance at Silas.

Doctor Hackensaw leaned back on his chair and laughed heartily.

"You've got me there, Miss Gloria!" he chuckled. "I always forget that the greatest inventions of all were the fundamental ones made ages ago. I verily believe that most young ladies would rather do without all the inventions of the nineteenth century than give up that of kissing. My new invention, of course, cannot compare with that, but I am nevertheless quite proud of my achievement, for I have discovered the means of giving man a sixth sense!"

"A sixth sense?" echoed the young lady. "Do you mean to say that, besides touch, taste, smell, hearing and seeing, there is a sixth way in which we may perceive objects?"

"That is precisely my meaning If I wished to carp on words, I should say that we possess at least seven distinct senses at present, for, what we call the sense of feeling is in reality at least three different senses. We can feel temperature—heat and cold. We can feel pain. And thirdly we can feel the form of bodies by touching them. These three kinds of feeling are entirely distinct senses, though it is convenient to lump them together."

"But," interrupted Silas, "you say you have discovered a new sense. Is it altogether different from any of our present senses?"

"Yes, entirely different," replied the doctor.

"What is it like?" inquired the young lady.

"It's not like anything," returned the doctor. "It is altogether different from anything you have ever experienced, and for that reason it is impossible for me to describe it to you. How would you give a man who had been born blind any idea of the gorgeous colors of a glorious sunset? How could you tell a man born deaf what the ravishing melodies of the bird-music in 'Siegfried' sounded like? And to a man who had neither taste nor smell, how could you describe the fragrance of a rose? It would be utterly impossible. All that you could tell them would be that it was harmony—delicious harmony. And so, all I can tell you about this new sense of mine is that it reveals new harmonies—divine harmonies—and as different from scents, sights or sounds as these are from each other. But I'd better begin at the beginning if I am to make my invention clear to you.

"To begin with, I will state that all our senses, in the last analysis, consist in the perception of vibrations. Some people will deny this of the senses of smell, taste and feeling, but as all our senses are evolved from the sense of feeling, I am convinced they are all fundamentally alike, and all explainable by the corpuscular theory of light. I have no use for the 'ether' theory of light, that presupposes an ether so attenuated that it can penetrate and find a path between the atoms of bodies, and be at the same time a million times denser than lead!

(*Continued on page* 1206)

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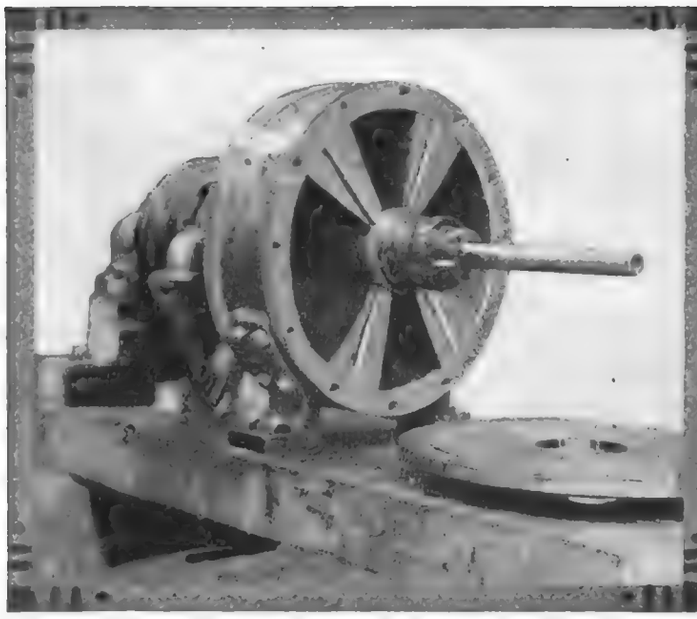


The Green Engine Disassembled, Showing Its Component Parts.

Mr. Green and a 75-Horsepower Model of His Invention.

New Crank-Less Auto Engine

MECHANICAL engineers in Los Angeles are greatly interested in the development of a new gas and steam engine which has just been invented and patented by James W. Green of Portland, Ore.

The leading feature of the Green engine is that it operates by means of two impellers, mounted at right angles to each other, having four ends, upon one end of a shaft or axle. These are fully shown in the view of the open cylinder given above.

When an explosion occurs between the impellers, in the chambers, the impellers cannot go back, as they do on the roller ratchet systems. The interlocking of the impellers in the cylinder prevent them from doing this as they lock rearwardly as the explosion occurs.

While one chamber explodes and pushes one impeller ahead, the chamber just ahead of it exhausts, the one ahead of this takes in gas, and the one just behind the explosion compresses its charge.

—*Photographs by Howard C. Kegley.*

[*It may be mentioned in passing, that a wooden model of a machine similar to this, was submitted to us for "Patent Advice" more than two years ago, and we suggested that the inventor proceed applying for a patent for the same, foreseeing the possibility of a novel and useful machine at that time.*—ED.]

Another Crankless Gasoline Engine

A CRANK-LESS gasoline engine? "An impossibility," you say? Not at all. This "impossibility" is just what two wide-awake men have disproved in the last three years. The principle of the engine was discovered by James E. Emley, a Florida inventor, and the development work has been carried on since then by Dr. E. H. Armstrong, a New England capitalist, and several associates.

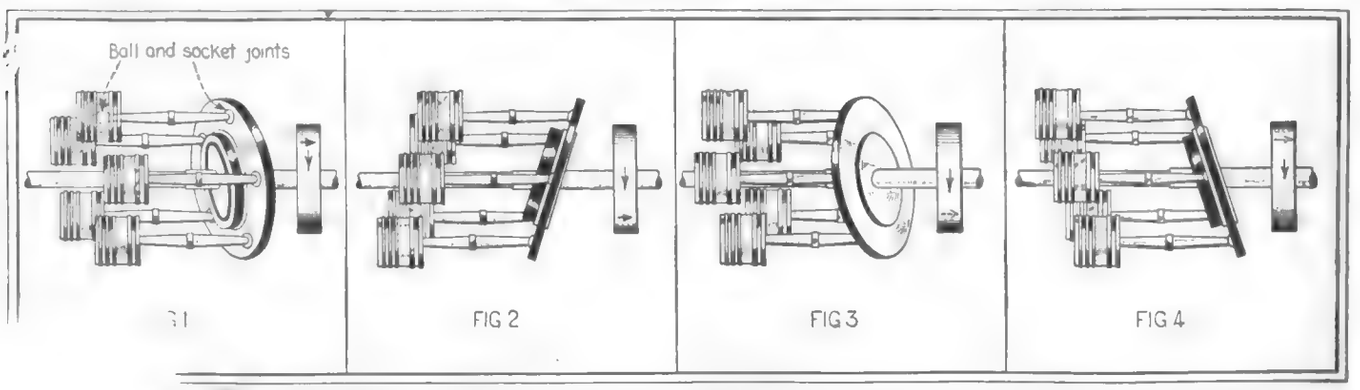
In the main, the engine is constructed on conventional engineering lines, with the exception of the method of transmitting the power from the pistons to the drive shaft. This is accomplishd in a manner hitherto undiscovered. The mechanical efficiency of the very best gasoline automobile engine is about 50 to 51%, but the new crank-less engine devised by Mr. Emley is said to develope an efficiency of 77%.

The main feature of this new engine lies in the *wobble* plate shown in the accompanying illustrations. The *wobble* plate spoken of above is fastened directly to the drive shaft at a certain predetermined angle by means of keys and bolts. This plate is made in two sections, so made that when they are screwed and bolted together there will be a slot provided in the edge. In this slot and in movable relation to the plate is placed a steel ring, to which is fastened the connecting rods by means of ball and socket joints. With an assembly of this kind it is found possible, by means of a nearly straight thrust on the ring, to rotate the disc and drive shaft. The resulting torque on the shaft in relation to the power applied is a revelation in the transmission of energy. To obtain a clear idea of the action of the mechanism it must be remembered that the ring does not revolve, but merely oscillates back and forth.

This results in a practically vibrationless engine, thereby giving longer life to the machine itself as well as to the automobile if it is used in one.

In a trial trip the engine drove a car on an average of thirty-nine miles on one gallon of gasoline. This engine had a stroke of five inches and a bore of three and a quarter inches, and developed 24.9 horsepower. The valves, half-time gears, ignition, etc., were all of standard design.

One of the reasons for the slight amount of wear is that the pistons, because of the fact that their thrust against the ring is exerted at so slight an angle, turn slightly on every stroke. Because of this the pistons and ball joints wear equally at all places, insuring longer life.



...e Views of the Positions of the "Wobble Plate" of the "Emley" Crankless Engine, Showing Its Action, Are Given Above.

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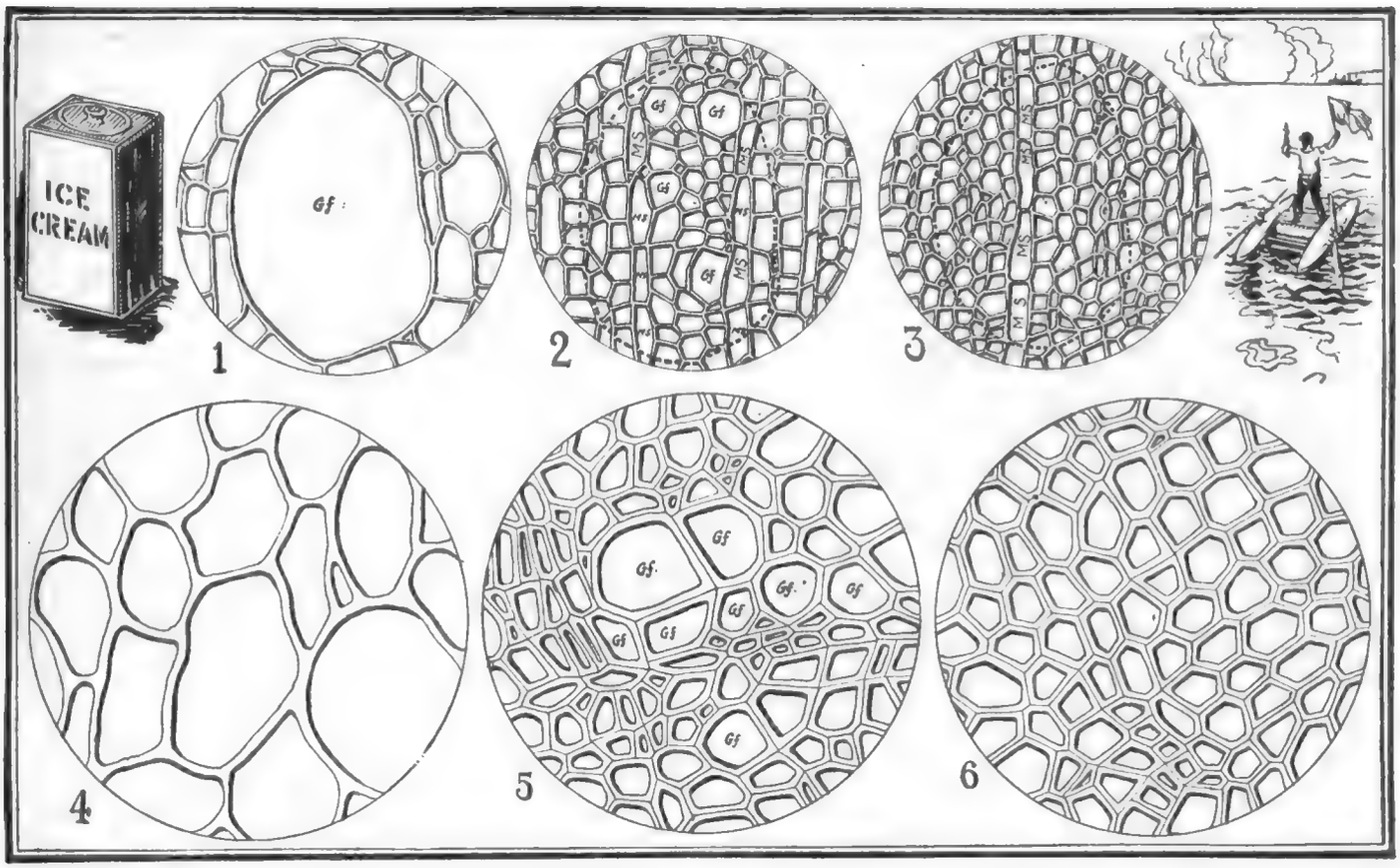

Balsa, lightest of woods, is widely used for life rafts, preservers, iceless ice cream boxes, etc. Fig. 1 shows cross-section of balsa wood. GF pore, magnified 120 areas. Fig. 2, section of linden wood, magnified 120 areas. The dotted line is the space which represents the pore of the balsa wood. Gf pores of the linden wood; MS pith cells; the other cells are lignose. Within the dotted lines there are 87 cells and pores. Fig. 3, section of fir tree magnified 120 areas. The dotted line in the space represents one pore of the balsa wood. MS pith cells; the other cells are lignose cells. Within the dotted lines there are 112 cells. Fig. 4, section of balsa wood magnified 310 areas. Within the circle there are 22 cells. Fig. 5, section of linden wood magnified 310 areas. Within the circle there are 105 cells and openings. Fig. 6, section of fir tree magnified 310 areas. Within the circuit there are 92 cells.

Why Balsa-Wood Weighs Light

By Dr. H. BECHER

IN recent years the wood of the balsa-tree has found extensive use on account of its light weight. It weighs less than cork. As long as its great capability of easily absorbing dampness and consequent rapid decay had to be taken into account, cork had the preference in most cases. But since successful measures have been found to prepare the balsa-wood by a preservative process, so it will not undergo such decay, its use for the manufacture of life-belts, buoys, pontoons, for cooling plants, refrigerators, and cooking-boxes has been enormously increased.

The balsa-tree grows in the tropical woods of Central and South Africa; it resembles the cotton-tree and the natives use it for making floats. In fact, from this latter the name of balsa is derived which means in Spanish float. On the average, balsa-wood weighs about one-third less than cork, but there have also been found pieces weighing less than half as much as cork.

Now, *what is the reason of this abnormal low weight?* In order to investigate this question, Dr. O. Heineck has made several series of vertical and longitudinal cuts through the bark of the tree, the wood and pith and found that there are several causes which co-operate in bringing about the low specific gravity of the wood. Even in the superficial aspect it is striking that the pith fills an extraordinary large part of the trunk. Microscopical examination shows that the walls of the vascular cells in the wooden part of the tree are not thickened or turned into wood and in this respect it differs from all other kinds of woods.

In all plants long vessels pass through these ligneous parts of the vascular processes, which have the shape of tubes carrying the water up from the soil to the leaves of the plant. In balsa-wood these tubes are rather wide, compared with those of the linden-tree, the wood of which also is of very light weight. Figures 1 and 2 show the relative width of these two kinds of pores. Now, as is clearly shown in 2 and 3, where in the balsa-tree those wide water-bearing pores pass through the wood, an enormous amount of wood-cells make up the inner port of the linden-tree and especially of the fir-tree. To represent the volume of one typical balsa-wood cell would require 87 cells and pores of linden-wood and 112 of fir-wood.

In the size of these cells, too, there is a remarkable difference. Within a certain space balsa-wood shows but 22 cells, though of relatively gigantic volume, while in that same space the fir-tree has 92 and the linden-tree 105 cells and vessels. All these particulars may be seen from the pictures.

From these facts it must be concluded that a piece of balsa-wood weighs much less than an equal volume of wood from the linden-tree or fir-tree. The light weight of cork is due to the thinness of the walls of its cells, which, are a great deal narrower than those of the balsa-wood.

X-Rays Substitute for Radium

A sharp decline in the price of radium has been caused by the development of high-power Roentgen ray machines, according to delegates who attended the fourth annual meeting of the eastern section of the American Roentgen Ray Society recently.

"It has been found that the biological effect of radium and the Roentgen ray is identical," said Dr. Charles A. Waters of Johns Hopkins University, Baltimore. Machines have been developed which cost upward of $10,000 and which produce the same radiation as half a million dollars' worth of radium. Rapid strides are now being made and we will be able to utilize 300,000 volts as soon as we can build tubes to carry this voltage."

Announcement was made of an offer of a $1,000 award by the American Roentgen Ray Society for the best piece of original research in the field of X-ray, radium or radio activity. The competition will close July 1, 1923 and the prize will be awarded by a committee consisting of Dr. George E. Pfahler, Philadelphia; Dr. Frederick Baetjer of Baltimore, and Dr. Geo. W. Holmes of Boston, to the winner.

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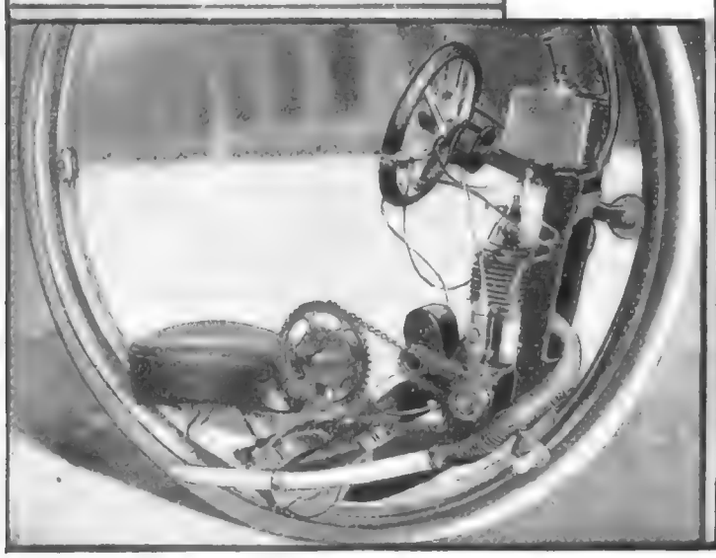
The Two Photographs at the Left Show an Interesting Motor Driven Uni-cycle, Which is Said to be Capable of Traveling at a Speed of Fifty-five Miles an Hour. This Novel Pleasure Vehicle was Made of Motorcycle Parts.

Photo at Right Shows Operator Talking Over a 70,000-Volt Alternating Current Transmission Line. This Trick is Accomplished by Utilizing a So-Called "Carrier Current," Which is a High Frequency Current Developed by a Vacuum Tube Apparatus Similar to a Radio Transmitter



Motorcycle Has Own Track

The unique motorcycle or rather uni-cycle shown in the accompanying illustration, is capable of making about forty-five miles an hour it is said. This peculiar pleasure vehicle has the parts of a motorcycle, including the seat and engine, built inside a single wheel rim, and is so arranged with pulleys, etc., that the outer rim is propelled around the driver and the machinery. In other words , you have a continuous track, which rolls round and round over your head. The inventor of this clever uni-cycle is Mr. Urbano Cislaghi, an Italian policeman. No doubt some of our youthful American geniuses and experimenters will want to try out Mr. Cislaghi's pet idea in motorcycles, and the whole affair can be readily rigged up with a few odd pulleys and parts added to an old motorcycle.

Talking Over 70,000 Volt Line

THE successful transmission of voice over electric power lines carrying 70,000 volts by carrier current, a new development of radio, was recently accomplished in Baltimore, Md. Tests were made by engineers of the General Electric Company over the high tension transmission lines connecting a substation of the Pennsylvania Water and Power Co., Baltimore with its hydro-electric plant at Holtwood, on the Susquehanna River, a distance of 40 miles. Conversations were carried on under every possible condition that might occur on a power transmission line, such as short circuits, grounding, and broken wires. The Baltimore installation of carrier current is among the first commercial application to central station communication. Similar outfits have been operating in Utica, N. Y., and Hartford, Conn.

The apparatus by which the transmission of voice is made is similar to a radio outfit, having vacuum tubes, batteries, and other appliances. Instead of radiating waves in all directions through space as from broadcasting stations, the voice waves are kept concentrated about the power lines, thus insuring privacy and the direction of signals.

A 220 volt storage battery is used to operate a motor-generator generating one thousand volts D.C. This is then passed through a fifty watt pliotron tube which gives about five thousand volts A.C. at fifteen thousand cycles. This current is then transferred to the transmission line through a capacitive coupler. A second fifty watt tube used as a modulator is then employed to superimpose the voice frequency on the higher frequency current, and the voice frequency is thus carried along with the carrier current. Reception is effected by apparatus similar to that used in ordinary radio, employing one detector tube and two stage audio frequency amplification. It is also possible to ring a signal bell before beginning conversation.

For power companies the carrier current system has many advantages over the land telephone, for, so long as there is a single transmission line in operation, communication can be carried on. Ordinary telephone wires, which are many times smaller than the high power electric lines, are generally the first to suffer during a storm, whereas transmission lines are seldom affected by even the most violent storms.

In the tests made in Baltimore the quality of the speech was much better than that obtained by land telephone over the same route. The conversation was free from hums and other noises which are usually experienced when a telephone line parallels a high power electric system.

A small switch connected with an ordinary telephone instrument does all the work. By moving this switch upwards, a bell is rung at the other end of the line. The switch then automatically returns to the neutral, or listening position, and the conversation begins. The apparatus is in operation only when a conversation is in progress, the telephone hook holding the receiver acting as a switch for the set.

Instead of radiating the sound waves into space, the high frequency carrier current is transferred to the transmission line by the condenser action of the capacitive coupler, the energy all being imposed on the electric power lines, and in the magnetic field that surrounds the wires.

Fifty watt sets are capable of carrying on communications for a distance of 85 miles. Larger sets of 250 watts are being made that will make it possible to extend the distance of communication to 260 miles.—*Photo Courtesy General Electric Co.*

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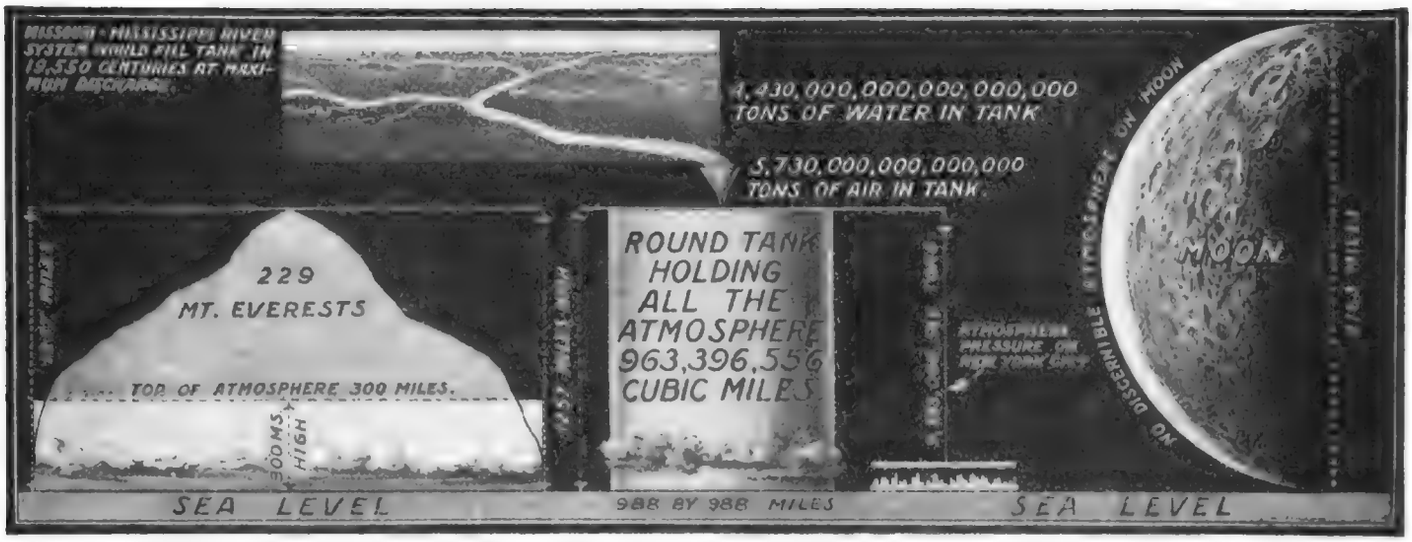
MISSOURI-MISSISSIPPI RIVER SYSTEM WOULD FILL TANK IN 19,550 CENTURIES AT MAXIMUM DISCHARGE
4,430,000,000,000,000,000 TONS OF WATER IN TANK
5,730,000,000,000,000 TONS OF AIR IN TANK
229 MT. EVERESTS
TOP OF ATMOSPHERE 300 MILES.
300 MILES HIGH
ROUND TANK HOLDING ALL THE ATMOSPHERE 963,396,556 CUBIC MILES
ATMOSPHERIC PRESSURE ON NEW YORK CITY
NO DISCERNIBLE ATMOSPHERE ON MOON
MOON
SEA LEVEL
988 BY 988 MILES
SEA LEVEL

The graphic chart above shows the vast size of a tank sufficiently large to contain all of the world's atmosphere. This tank would, for one thing, hold the waters of the Missouri-Mississippi River System if poured into it for 19,550 centuries. The tank would be as high as 229 Mt. Everests, as shown at the left, and its size would also compare favorably with the moon shown at the right.

How Much Does the Atmosphere Weigh?

By CHARLES NEVERS HOLMES

ALL of us are interested in the air surrounding us. To us, it is quite invisible. We do not feel its presence. Indeed, most of us have to be educated up to the fact that air possesses weight. Of course, we are aware that air offers some resistance. Such resistance is indicated when we fan ourselves.

If air offers resistance to motion, then it is *something*, and it must have weight. Inasmuch as air is an association of gases, a small amount weighs very little. Air is a mixture, not a combination of gases, 100 volumes containing 78 per cent nitrogen and 21 per cent oxygen, as well as carbon dioxide, argon, helium, neon, krypton and xenon.

All of us have heard considerable about nitrogen and oxygen. The former is a very inert gas, weighing about 14 times as much as the lightest known gas hydrogen. On the other hand, oxygen is exceedingly active, being a little heavier than nitrogen. Were our air pure oxygen, we should probably soon complete our life's course. As it is, nitrogen dilutes and diminishes the energy of oxygen in our air.

Water, also, contains oxygen, in combination with hydrogen. As we well know, water possesses a considerable weight. One cubic foot of fresh water weighs about 62½ pounds. Ocean water is slightly heavier than fresh water, owing to the salts it holds in solution. Compared with air, water weighs about 773 times as much.

Air has weight and even a *liter* of it—a measure equalling about one quart—weighs about 1-3/10 grams. A cubic foot possesses a weight of about 1-3/10 ounces. Taking this approximate weight of 1-3/10 ounces per cubic foot, a space having a capacity of one cubic mile would contain about 191,357,357,600 ounces, inasmuch as there are 147,197,952,000 cubic feet in a cubic mile. Or, divided by 16 and then by 2000, it gives approximately 5,980,000 tons of air.

If, therefore, one cubic mile of our atmosphere is so exceedingly heavy, how very great must be the total weight of air surrounding our solid Earth? It is certain that if air has weight, then it also has pressure, and this is proved by the height of the barometric column. In a barometer, atmospheric pressure will raise a column of mercury about 30 inches. Accordingly, the atmospheric pressure upon the whole surface of our body is no small amount. Indeed, were it not that our body is protected by an outward pressure equal to the inward pressure upon it, our bodily structure would have to be changed. As it is, if the air-pressure outside of our ear-drum becomes lesser or greater than that inside, we experience more or less discomfort.

Now, how much does our atmosphere weigh?

We know that the terrestrial surface contains about 197,000,000 square miles. Therefore, at first thought, it seems easy to compute the total capacity and total weight of our atmosphere. All we should have to do would be to find the atmospheric height. This atmospheric height has been rather satisfactorily estimated at about 300 miles. However, there are several important considerations. One of these is that our atmosphere's density is not uniform. The density and the pressure of the air decrease as we rise above the terrestrial surface. At an altitude of about 3½ miles above sea-level, atmospheric pressure is only ½ what it is at sea-level. And this rate of decrease continues as we ascend higher and higher.

Nevertheless, there are several methods whereby the atmospheric weight may be satisfactorily approximated. Scientists have computed that our atmosphere's total volume possesses a weight of about 1/1,200,000 that of the Earth. According to this computation, since the Earth's weight is approximately 6,000,000,000,000,000,000,000 tons, the atmospheric weight would be about 5,000,000,000,000,000 tons.

But this estimate seems much too low. The barometer proves that air at sea-level possesses a pressure of 14-7/10 pounds per square inch. Inasmuch as all of our atmosphere's weight presses upon the terrestrial surface, then its 197,000,000 square miles, or 790,854,451,200,000,000 square inches, multiplied by 14½ pounds, (the average pressure upon ocean, valley and mountain) will approximate the weight of the atmosphere—5,733,694,771,200,000 tons.

Moreover, calculations indicate that were the whole atmosphere concentrated to sea-level density, it would be only about 25,835 feet, instead of 300 miles in height. This concentrated atmosphere would contain about 141,886,977,408,000,000,000 cubic feet. If we multiply this sum by 1-293/1000 ounces (a cubic foot of air), the result is 183,434,001,788,544,000,000 ounces, our atmosphere's total weight. And this atmospheric weight in ounces, divided by 16 ounces and then by 2000 pounds, approximates 5,732,312,500,000,000 tons. Therefore, inasmuch as this calculation verifies very closely the calculation at the end of the paragraph just above, it is evident that the total weight of our terrestrial atmosphere approximates 5,730,000,000,000,000 tons.

Lloyd Dam Named

The Lloyd Dam in the Deccan, described in the London *Times* Trade and Engineering Supplement as the largest of its kind in the world, was recently the object of a ceremony at which Sir George Lloyd, Governor of Bombay, after whom it was named, was present.

The work was begun in 1913 to give relief to a Deccan area particularly liable to famine. The pioneer plan, carried out between 1881 and 1892, provided a dam at Bhatgarh, known as Lake Whiting Dam, and a canal on the left bank of the Nira River to protect an area of about 300,000 acres. The new dam will store about five times as much water as the existing dam, and will protect some 900,000 acres on both sides of the Nira Valley.

The dam is more than a mile in length, with a maximum height of 190 feet and a width at base of 125 feet. The volume of the masonry used in its construction will approach 22,000,000 cubic feet, or three millions more than in the case of the Assuan Dam. The project will cost approximately £3,333,333. Full advantage has been taken of the natural resources of the site to develop electric energy to the extent of 2,000 h. p., which is used for driving machinery. Two waste weirs with eighty-one openings each of 10¼ feet, of which forty-five are fitted with automatic and thirty-six with roller gates, are built into the body of the dam.

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DARK COSMIC CLOUDS

Spiral Nebula in Andromeda Viewed Edgewise, Taken With 60-Inch Reflector of the Mt. Wilson Observatory. Showing Dark Absorbing Matter Surrounding the Central Luminous Part of the Nebula. Particular Attention is Called to the Black Space, Which is Thought to Contain Great Masses of Dust, Which Does Not Allow Light to Pass. Such Masses of Dust Are Found Throughout the Universe, and Constitute Not a Small Quota of Space. This Dust is Usually Found in Great Quantities in or Somewhere Near Our Great Nebulae.

Bright and Dark Cosmic Clouds South of Zeta Orionis. Photograph Taken With the 100-Inch Hooker Telescope of the Mt. Wilson Observatory. Note the Conspicuous Dark Cloud Just Below the Center, Known as the "Dark Horse Nebula." It Will Be Seen That the "Dark Horse Nebula" Takes Its Name From the Shape, Which Resembles That of a Horse's Head. It is One of the Most Remarkable and Puzzling Objects in Our Heavens, and it Has Never Been Fully Explained. If it is Composed of Cosmic Dust it is Remarkable That it Keeps Its Shape Year In and Year Out. It Might Be Reasoned That if This Immense Amount of Matter is Dust, the Shape Should Undergo Variations, But This, So Far, Has Not Proven to Be the Case. There Must Be An Enormous Amount of Such Matter Contained in This "Horse's Head," For Stars Do Not Shine Through it Except in Some of the Lower Portions.

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Popular Astronomy

By ISABEL M. LEWIS, M. A.

Of U. S. Naval Observatory, Washington, D. C.

The Cosmic Dust Clouds of Interstellar Space

WITHIN the past few years the attention of astronomers has been particularly attracted to the dark markings of the sky, not only the dark rifts and streaks that occur profusely among the dense star clouds of the Milky Way, many of which are true vacancies among the stars, but also the huge cosmic clouds of interstellar space the existence of which has been made known in a variety of ways.

The most remarkable contribution to this branch of astronomical investigation is that of Rev. J. G. Hagen, S. J. of the Vatican Observatory, who maintains that his telescopic observations of catalogued nebulae as well as independent sweepings of the heavens with the telescope during the past twelve years show that the entire sky is covered more or less with obscure nebulae which are densest in the neighborhood of the north pole of the Milky Way.

These dark nebulae encompass the Milky Way system of stars on either side, Father Hagen's observations show. Their presence is revealed, he states, by the neutral greyish tint and general dullness of the field of view and absence of stars, also by the fact that the borders of the dark regions are often lined with regularly spaced rows of stars and luminous types of nebulae such as the small spirals. The denser the cloud the more abundant are the bright nebulae along its borders. The interiors of these dark clouds are apparently avoided by bright stars and luminous nebulae. Within the Milky Way itself these clouds are far less prevalent, appearing only occasionally in the form of dark patches or thin veils. Only in the vicinity of dense star clusters is a clear, dark sky to be found, free from these dark cosmic clouds. The study of these objects must be made visually because it is impossible to photograph them except in the vicinity of bright stars which either illuminate them or excite them to a state of gaseous emission. In general they are illuminated only by the diffused light of the entire stellar system. The zodiacal light, that faintly luminous belt that may be seen at times, particularly in the tropics, arching across the heavens along the ecliptic after sunset, is, Father Hagen believes, an example of one of these interstellar wisps of nebulosity that is located by chance close to the solar system. It has been the generally accepted view that the zodiacal light consists of a cloud of dust-like particles revolving around the sun in the plane of the ecliptic and illuminated only by reflected sunlight.

The giant red stars, which represent, it is now generally conceded, the first step in the evolution of the stars may be formed, Father Hagen suggests, from these dark cosmic clouds, which abound in interstellar space by a concentration of the nebulous matter into huge globes and then by contraction of these masses into luminous stars. This concentration and contraction takes place along the borders of these vast, dark clouds and not in their interiors.

Father Hagen urges that this work of sweeping the heavens for dark cosmic clouds be taken up at other observatories and states that if the instrument is properly chosen no great difficulty will be experienced in detecting such clouds by the characteristics which have been mentioned, namely neutral greyish tint, dearth of stars and the fringe of bright stars and luminous nebulae usually to be seen along the borders. Since the observations can only be made visually and a large telescope is not a requirement, here is an opportunity for the amateur astronomer to do some work of value.

Aside from Father Hagen's observations there are numerous indications of the presence of vast dark clouds in space absorbing the light of stars beyond them. Observations of many binary stars and novas have revealed the presence of absorbing matter lying between the observer and the star which does not share in the motion of the star through space.

When these dark clouds are in the vicinity of bright stars they become luminous either by reflected light from associated stars, as in the case of the nebulosity surrounding the Pleiades, or by gaseous emissions excited by some nearby star, or stars, as in the case of the Great Orion Nebula in which the bright nebular lines are due to electrical excitation caused by the multiple star Theta associated with the nebula.

It is known that the electrical excitation of a dark nebulous cloud by neighboring stars may extend to distances as great as twenty light years and that the intensely hot and giant helium and hydrogen stars are almost invariably the cause of the luminosity of these clouds. The red, dwarf stars are not capable of producing these effects and are rarely if ever associated with the luminous portions of these cosmic clouds.

Dr. Henry Norris Russell, who has also made a study of the dark cosmic clouds, finds that they are practically opaque to light and considers that they are probably composed of dust particles, the obscuring power of the cloud depending upon the size of the particles. These dust particles are strongly affected by radiation pressure emanating from nearby stars. In the case of the giant helium and hydrogen stars this radiation pressure is so effective, that only the coarser particles can remain in their vicinity. The finer particles, which are the most effective in cloud formations, are driven away into intersteller space, where they drift about in the form of dense clouds. The absorbing clouds in Orion, Dr. Russell believes, weaken the light of stars behind them by at least ten magnitudes, that is, the light of such stars in passing through these obscuring clouds is reduced to one ten-thousandth part of the brightness that they would possess if the clouds were not there. The Great Nebula in Orion he considers to be a superficial fluorescence of the gaseous portion of an enormous dark cloud which is visible only in the vicinity of the exciting stars. In the course of time the appearance of the Great Nebula probably changes as different portions of the huge cloud drift into the field of excitation of the associated stars.

That remarkable photograph of bright and dark nebulae south of Zeta Orionis, one of the stars in the belt of Orion, taken with the 100-inch Hooker telescope, shows a small portion of the enormous cosmic cloud that envelops the entire constellation of Orion. Note the dearth of stars in the right hand portion of the photograph, where the obscuring cloud is most dense as compared with the more luminous and less dense portion on the left, which is less effective in absorbing the light of stars beyond.

Many stars and many of the spiral nebulae viewed edgewise show the effects of absorption of their light by surrounding clouds of non-luminous particles. Some astronomers go so far as to say that probably all stars and nebulae are surrounded more or less by such absorption rings. Those surrounding the brighter and hotter stars would be of great extent and might even extend as far as neighboring stars. Possibly the zodiacal light is an indication of the presence of such a ring of absorption about our own solar system.

As to the origin of these clouds of dust particles that apparently surround many of the stars and nebulae, it is possible that they consist chiefly of minute particles of matter that have been driven off from the stars themselves by radiation pressure which at times of unusual activity, as during the sunspot maximum periods of our own sun, may exceed the gravitational attraction existing at the surface of the star. The solar corona is, as we know, largely composed of such small particles electrically excited to luminescence and in its non-luminous parts the corona may extend to enormous distances from the sun.

In the case of the hotter and more massive stars the effects of radiation pressure would be far greater than in the case of our own dwarf star and the dark clouds surrounding such stars would be more easily detected, as they have been in many cases.

A most interesting and remarkable spectrum of the starlit sky has been obtained recently by Dr. V. M. Slipher of the Lowell Observatory which may possibly have some bearing on this subject of the existence of vast cosmic clouds in interstellar space. By making a total exposure of one hundred and fifteen hours duration with an instrument that was particularly powerful and specially adapted for this purpose, a spectrogram was obtained of a zone of the heavens about six degrees wide, half encircling the north pole of the heavens at a distance of about ten degrees from it. This region contains no bright stars and very few faint stars lying within the reach of unaided vision, so the light entering the spectroscope was chiefly that of the faint stars and the starlit background. The spectrum obtained was a new and most unusual type and not a combination of the most prominent stellar types, as might be expected. Strange, as well as familiar, absorption bands appeared in it, and also certain bright emission bands of unknown origin that gave to the spectrum a most peculiar appearance and seemed to indicate the presence of matter in some unknown form in the depths of space. Evidently the light of the stellar background differed conspicuously from that of any known type of star. The observations are so recent that little time has been afforded as yet for an interpretation of the nature of this "spectral sounding of the depths of space" as Dr. Slipher calls it. Whether the light came from some strange types of stars or nebulae lying on the outskirts of space and individually beyond the reach of the most powerful telescopes or, possibly, from faintly luminous clouds of cosmic dust floating through interstellar space is a question that cannot be answered until the subject has been studied more exhaustively.

Since it is now reasonably certain that enormous clouds of dust particles and possibly also coarser swarms of particles of

(*Continued on page* 1216)

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Magic for Everybody

By PROF. JOSEPH DUNNINGER

NO. 1 OF A SERIES.

PRIOR to beginning this series of articles upon popular conjuring, mind reading, telepathy and general mysteries purporting to be on the mental order, a few words of introduction will be in place. It is not my desire to expose the conjurers' greatest mysteries or to lay bare the secrets of famous illusions. To my thinking the general theatre-going public enjoy the mystification due to modern stage illusions and deciding for themselves how the trick is done; an explanation prior to witnessing a demonstration would be injurious to the interest supposed to be excited. The average theatre-goer would no more desire to know in advance how an illusion is accomplished, than he would care to be told the story of a play before seeing the same acted. The average stage effect such as produced by present day illusionists may involve an investment of thousands of dollars and the secret of an effect of this kind would be of no value to the readers of this paper because it is doubtful whether anyone not a professional would care to invest such a sum of money to duplicate the effect simply for one's amusement.

It is, therefore, my desire to expose a series of effects, which cost but little to construct and can be accomplished with little practice, yet will be such as to appear to be bordering upon the impossible and will have to all appearances as mysterious an effect as would be found in more costly and difficult experiments.

THE BLOCKS OF THE YOGI

This weird and startling effect is one that I originated some eight years ago and which has been the means of mystifying quite a number of professional magicians. Two small blocks of wood are passed around for thorough inspection. It is found that both are three inches long, one and one-half inch wide and about one-half inch in thickness. Closest inspection will reveal no difference other than the color. The one is painted a bright vermilion red, the other block a dull black. The performer requests a subject from his audience to take these blocks into another room with him and to place the blocks in different side pockets. The subject re-enters the room and the performer is at once able to state which pocket holds the red block and which the black one. Still another test is made; while in another part of the house the blocks are separately wrapped in sheets of paper and the performer is still able to indicate the packages containing the red and black respectively.

WE take pleasure in introducing to our readers Dunninger, the Master Mind of Modern Mystery.

Mr. Dunninger will write for the next twelve months monthly articles on Modern Magic. Mr. Dunninger, who is a disciple of the famous Kellar, is no doubt the greatest exponent of this art in the United States today. He has performed before many audiences in the New York Hippodrome, as well as in Madison Square Garden.

Among the individuals whom he has entertained a number of times appear such famous names and titles as the late Theodore Roosevelt, the Prince of Wales, Governor Alfred Smith of New York, Mayor Hylan, of New York, Hon. John Wanamaker, Thomas A. Edison, Mrs. Wm. R. Vanderbilt, Mrs. Perry Tiffany, Mrs. Nathan Strauss, Colonel Dupont, Mrs. John Jacob Astor, Mrs. O. H. P. Belmont, Mrs. Stuyvesant Fish, Mrs. Edwin Gould, Mrs. Wm. G. Rockefeller, and Mr. Charles M. Schwab.

We are quite certain that our readers will welcome the new addition to SCIENCE & INVENTION'S family of writers.—Editor.

Prof. Joseph Dunninger, Master Magician, and Mind Reader, Author of Our New Series of Magic Articles.

In spite of the weird and mystifying effect produced by a performance of this trick, the secret is extremely simple but still remarkably clever. With reference to the diagram, one will find that in the black block, which really consists of two pieces of wood carefully glued together, is secreted a piece of magnetized steel. The red block is likewise treated but the metal (zinc or copper) therein concealed is not magnetic. Its purpose is only to give it the proper weight to be in positive harmony with the other block. The performer has a small compass concealed between the fingers of his hand. This compass has a plate case which is flesh colored so as not to be easily noticed. Naturally all that remains to be done in order to discover the package or pocket containing the black block is for the performer to pass his hand over such package or pocket, apparently only for effect, but in reality the reader will understand for the purpose of having the block indicate its presence as the magnetized steel will cause the compass needle to move. Many other experiments with the blocks will suggest themselves to the readers as one will readily see that the array of possibilities is unlimited.

A HINDOO MYSTERY

Several years ago a certain Hindoo mystic was practicing his apparent powers of witchcraft and enchantment in one of our largest cities and succeeded in obtaining large sums of money from many of our foremost society leaders and business men by his illusions. This method of a get-rich-quick schemer became the talk of the town until his psychic power came to a sad ending through police detection. I will herewith lay bare a method which he employed which proved to be one of the best

One Block of Wood is Red, the Other Black. Both are wrapped in Newspaper and Then Placed in the Vest Pockets. With a Slight Flourish of His Hand the Magician Informs the Holder of the Blocks in Which Pocket Each of the Colored Blocks is Located. A palmed Compass and a Magnet Concealed in One of the Blocks Solve the Mystery.

A Deck of Cards is Shuffled up, Placed Into the Magician's Pocket and One Withdrawn. The Holder of the Card Now Telephones to a Town Some Fifteen Miles Distant, Where the Individual Answering the Phone Correctly Informs Him of the Number of Spots on the Card and Its Suite. A Prepared Deck Containing Cards of But One Suite, a Double Pocket, and Some Friend Who Knows the Trick, Are the Sole Requirements.

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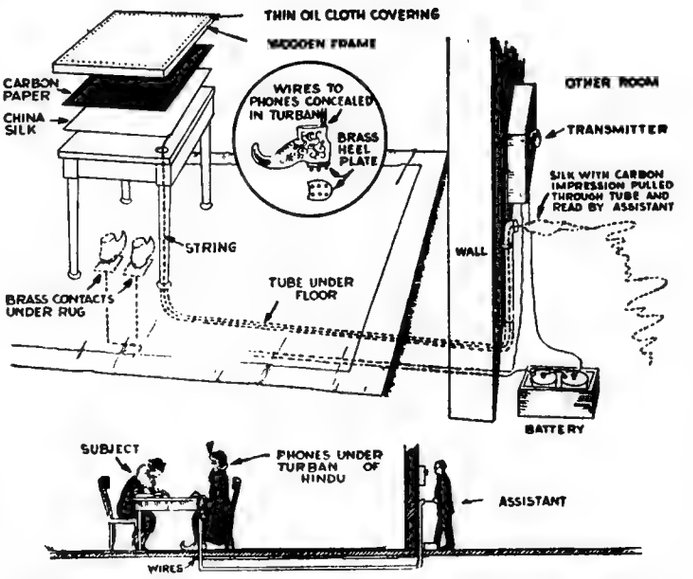
mechanical methods for weird impression that has ever been practiced. Briefly, here is the method of his operation. The subject would enter the mystic's parlor, which was found to be elaborately trimmed with an array of zodiac charts, ancient hierogliphics, incense pots, skulls and other weird uncanny objects to make the psychic's work more impressive. After waiting for five or ten minutes, the weird-looking gentleman would enter the room from behind a pair of antique portierres. The subject would be ushered to a chair directly in front of a table, upon which lay a pad, a candlestick containing a burning candle, two incense pots and several pencils. The Hindoo wonder-worker would seat himself upon a chair directly opposite the subject. After a brief interview with reference to the month, day and year in which the subject was born and other apparently necessary questions relative to his horoscope, the Hindoo would finally ask him to take a sheet of paper from his own pocket if necessary and to write upon it five or six questions, which he would wish to have answered. After these had been written he was requested to put this paper into his pocket or to burn it in the flame of the candle as his desire would dictate. After a few moments of ceremony, the Hindoo would begin to call the subject's questions and in a low mysterious tone answer them to the subject's entire satisfaction. Not alone would this information be given to the spectator, but a series of questions and experiences with his friends which, while apparently unknown to the mystic were called by name, followed by their addresses, etc., would be mentioned, naturally producing a bewildering and uncanny effect upon the subject, who could not possibly doubt the genuineness of his occult powers after a demonstration as convincing as this.



A Mystic for a Long Time Fooled His Followers by the Simple Trick Shown in the Diagram Above. A message written on a Sheet of Paper Produced a Carbon Copy on a China Silk Sheet Located Under the Oil Cloth Covering of the Table. This Carbon Copy Was Withdrawn by the Assistant Through the Hollow Leg of the Table to a Distant Room, Where the Questions Were Transmitted to the "Man of Mystery" in the Ordinary Telephonic Manner.

Now for the explanation: As in all cases of the greatest apparent mysteries, the explanation is extremely simple. The table, apparently an innocent piece of furniture, is partly responsible for the success of this effect, as will be noted by the diagram. One of the legs of the table is hollow. Over the top of the table a sheet of thin white China silk has been previously placed, to one corner of which a string is affixed, which passes down the leg of this table through a tube leading into another room. On top of this silk is placed a large sheet of carbon paper, and above this affair a rim of wood with a thin oil cloth top. It is, therefore, noted that although the table appears to be nothing more than an unprepared card table, it is in reality a traveller for information. The paper upon which the subject writes naturally rests upon the top. As the writing is done, a secret carbon copy is produced on the silk through the cloth of the table top upon the sheet of silk exactly as in office practice. At the proper moment the sheet is drawn down through the table-leg and through the tube into the hands of the assistant hidden in the other room. The diagram will further disclose the fact that a telephone arrangement consisting of a receiving apparatus concealed in the turban of the Hindoo's costume leads off to a transmitter in the assistant's room. All that now remains to be done is for the concealed assistant to transmit the information secured by reading the carbon copy on the silk sheet to the wizard. Other information has also been obtained unknown to the subject. When he entered this "palace of mystery" he was asked to hang his coat upon a rack in the hall leading to the den. This was done ostensibly so that he might wear a robe or mantel which was furnished him by the attendant. In reality, however, it was the means of supplying additional information to the Hindoo. During the period of conversation between the subject and the wizard, the assistant would go through the pockets of the subject's coat hanging upon the rack and read whatever letters, papers, addresses, visiting cards, and the like, might be contained therein. All this information naturally was transmitted to the Hindoo by this telephone contrivance. It will be noted that the magician has the freedom of walking about and can at the proper time secure the proper telephone connection by placing the heels of his shoes upon two (or more pairs) plates secreted under the carpet, thus forming the necessary connection. To the metal shoe heels, of course, are affixed a number of spikes which penetrate the fibres of the carpet and come in direct contact with the plates. The writer feels that the exposing this weird and extremely clever method of fraud will operate as a form of education to those desirous of parting with large sums of money for a look-in upon the boundary of the odd, fascinating, occult side of mystery.

THE TELEPHONE MYSTERY

This interesting method of proving the existence of mental telepathy has been used by some of our foremost mind-readers with signal success. A deck of cards is freely shown and inspected. The mind-reader places the deck of cards in his pocket and requests one of his subjects to remove one card therefrom. The subject is now asked to concentrate upon this card for several moments. Another member of the audience is directed to go to a telephone and call up the mind-reader's assistant, who, at a distance of some twenty miles or more, distinctly states the correct suit of the card selected.

The explanation is simple. To begin with, two decks of cards are employed. For the one, an ordinary deck, purchasable anywhere is used. The other deck consists of 52 cards of one suit and one denomination. For example's sake, we will say, all are jacks of diamonds. The pockets of the trousers in which the deck is afterward placed really consists of a pocket within a pocket. The original or unprepared deck descends into the lower pocket, as indicated in the diagram. It now will be seen by the reader that when the subject places his hand in the performer's pocket with the intent of removing one card, he is bound to remove the jack of diamonds, regardless of which of the 52 he may happen to draw. The assistant to the performer, who has been stationed at the other end of the 'phone, of course, understands that his part of the mystery consists in acting with hesitation for effect, and slowly repeats THE JACK OF DIAMONDS over the 'phone. The jack, of course, has been removed from the unprepared deck, so that when the same is again brought to view from out the performer's pocket, the secret of the trick would not be overthrown by the discovery of another jack of diamonds.

Don't miss the next installment in the May issue.

WATER FOR LOCOMOTIVES

Locomotives are hard drinkers. On the famous non-stop run to Plymouth of the Great Western *Cornish Riviera* express—the longest daily journey of its kind in the world—the engine needs to be refreshed with a modest total of some 40 tons of water while covering the 226 miles between Paddington and North Road.

Such a weight is equal to that of the largest and heaviest dining-car, and it would be a very uneconomical proceeding to haul right through the run a tender capable of holding this vast quantity of *drink*. Actually the water storage capacity of the tenders coupled to these engines is about 3,500 gallons.

Thus, in order that the train shall not be compelled to stop specially for water, arrangements must be made to pick up at speed the precious fluid. This is done by providing between the rails those long, shining *ribbons* of water, with the sight of which every long-distance traveller is familiar.

The *track-trough* has a length of just over a quarter of a mile, is about 18 inches wide and 6 inches deep, and is generally constructed of steel.

As the engine approaches the trough the driver lets down under the tender a movable *scoop*, shaped somewhat like a shovel. The sharp lower edge of this scoop cuts off the *top layer* of the water, and the momentum of the train forces this up through a large vertical pipe with a mushroom head into the tender tank.

From 2,000 to 3,000 gallons of water are picked up in some 15 or 20 seconds, the exact quantity varying according to the speed of the train. Curiously enough, the greatest quantity is not lifted at the highest speeds, as very fast traveling tends to scatter the water in spray.

The right speed for taking the maximum amount is about forty miles per hour.

An important part of the equipment of the troughs is the large storage tank at the side of the line, with its sensitive ball-valve, which enables the long trough to fill again rapidly after each train has passed over.

Without this arrangement, if two trains were following one another across the trough at a short interval, the engine of the second would have to go thirsty—*Sea, Land and Air.*

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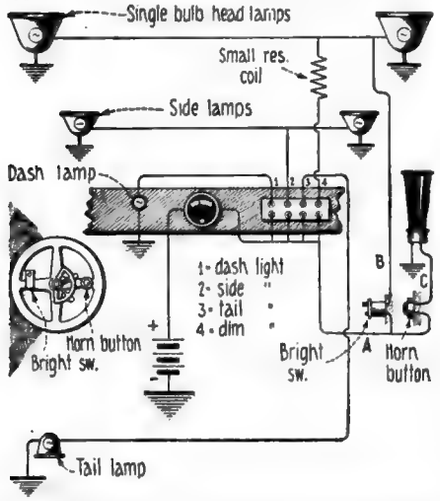
MOTOR HINTS

FIRST PRIZE, $25.00

LIGHT AND HORN BUTTONS ON WHEEL

In the accompanying sketch is shown a wiring diagram for lights and horn, which I have installed to eliminate the necessity of releasing the hold on the steering wheel wtih either hand, in order to sound the horn or to dim the lights. The horn button and bright light switch are attached to the opposite webs of the steering wheel, the



Convenient Method of Mounting Dimming Switch for Headlights and Also Horn Button, on Steering Wheel of Car.

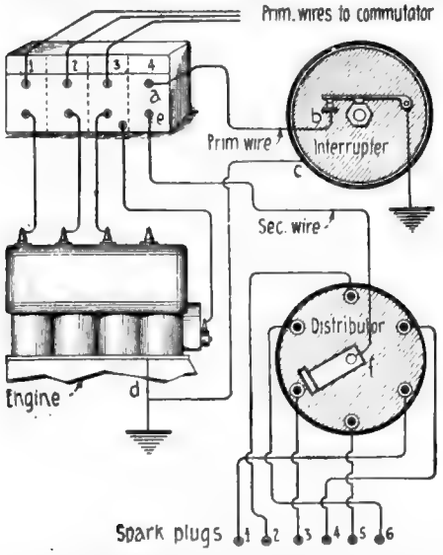
former accessible to the right thumb, and the latter to the left thumb. The three wires A, B, and C, run up the front of the steering column, to the wheel, the motion of which is taken care of by using flexible wire, and allowing about six inches excess directly under the wheel. This has given me three years' service without trouble.

Contributed by H. E. SAHLI.

SECOND PRIZE, $15.00

STARTING A CAR FROM A FORD MAGNETO

The device described here will be usefui to the motorist whose battery is discharged.



How One Motorist Started a Stubborn Car from the Magneto of a Ford Car.

and a recharge or another battery cannot be obtained readily. The Ford magneto supplies the current. The commutator and spark plug wires are removed from one of the Ford coils. A piece of insulated wire is attached to the primary terminal A, and connected to the interrupter points B. Next the secondary terminal, E, is connected to the center of the distributor at F. A ground connection is made from one car to the other. The Ford coil vibrates from the time the contact points are closed, until they are opened. The timer is set for the spark to occur when the points are just broken. Therefore, it is necessary to reduce the timing. This is done by turning the engine over until the contact points are just broken. The jam nut is this loosened, and the distributor arm is moved backward, until the points are just broken in this direction. After locking the jam nut, replace the distributor. Now we will proceed to start the dead car. First the Ford is started, and the dead car is cranked with the crank in the usual way. Let the cars run in this manner until the battery is sufficiently charged to start the car. The timing is advanced by turning the engine over until the contact points are just closed, and the distributor arm is moved forward until the contact points just break.

Contributed by HAROLD SHIREY.

ELECTRICITY ON THE CAR

We believe that there are hundreds of new electrical ideas that can be incorporated in the car that our readers would like to know of. What we are particularly interested in are novel stunts, new devices, new kinks, and new hints made possible by the electric current.

In order to win a prize the first requisite is that the device or suggestion be practical. The term PRACTICAL will be the keynote of this contest.

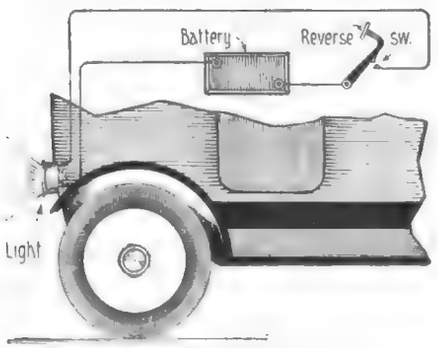
You will be more apt to win a prize if you will design the device yourself, and make a photograph of it, sending the same to us. Ideas are all right, but the reader wants to see that the device actually has been made, and WORKS.

The following prizes will be paid:

FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles which will win no prizes will be paid for at the rate of $1.00. Each article submitted should not be longer than about one hundred to two hundred words.

Address all manuscripts to EDITOR "MOTOR HINTS," care of this publication.



Have You a "Backing Up" Light on Your Car? It May Save You a Damaged Body or Gasoline Tank

THIRD PRIZE, $10.00

"BACKING UP" LIGHT

Oftentimes on a dark night, one experiences great difficulty in backing out of a strange place. To overcome this difficulty, I installed on the back of my car one of the cheap spotlights now on the market. This light I connected to the storage battery, through a switch fastened to the reverse gear. On cars having no reverse pedal, the light can be controlled by a small hand switch mounted on the dash, or else rigged up to the gear shift lever.

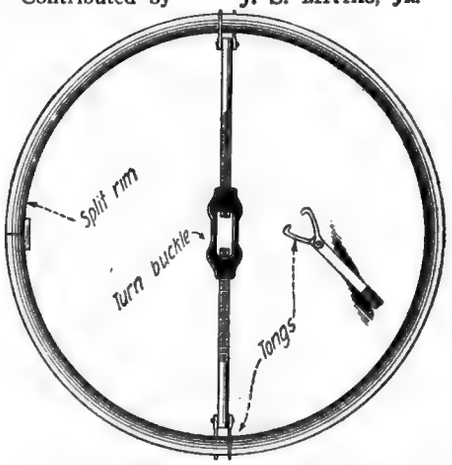
Contributed by H. M. PRICE.

HANDY TOOL FOR SPLIT RIMS

A turnbuckle with threaded 1-inch rods and two pairs of tongs which can be made by a local blacksmith are the only implements necessary.

In the drawing the tool is depicted in the act of contracting the rim; by throwing the tongs back and placing the ends of rods against inside of rim, it can be used equally as well as an expander.

Contributed by J. S. MITTAG, JR.

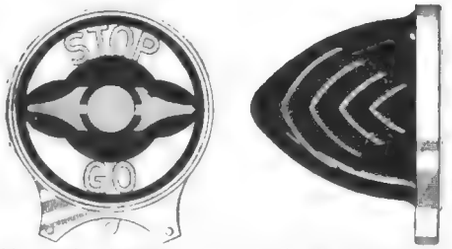


A Simple Tool for Expanding or Contracting Split Tire Rims.

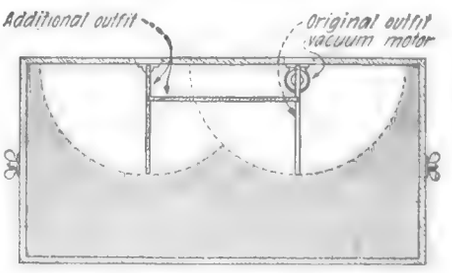
AN ELECTRIC TRAFFIC SIGNAL

I use a conical-shaped dome, which is removable, and contains an electric bell and two arrows with the words "STOP" in red letters, and the word "GO" in green letters. Three buttons on the steering wheel operate the signals. The first button, when worked, shows the word "STOP" and rings the bell for attention of the other driver in rear. The middle button causes the word "GO" to appear with the right arrow for the right direction, with ringing of bell, while the third button, when worked, says "GO" with the left arrow for left turns.

Contributed by STEVE MILLER.



Above—An Ingenious Electric Traffic Signal for the Rear of the Car; Below—Two Wipers Keep the Whole Windshield Clean.



DUPLEX WINDSHIELD WIPER

I was unable to see the road when turning corners in rainy or stormy weather. I thereupon hit upon this double wiper idea which gives twice the service with very little additional cost.

Contributed by FRANK G. DUROY.

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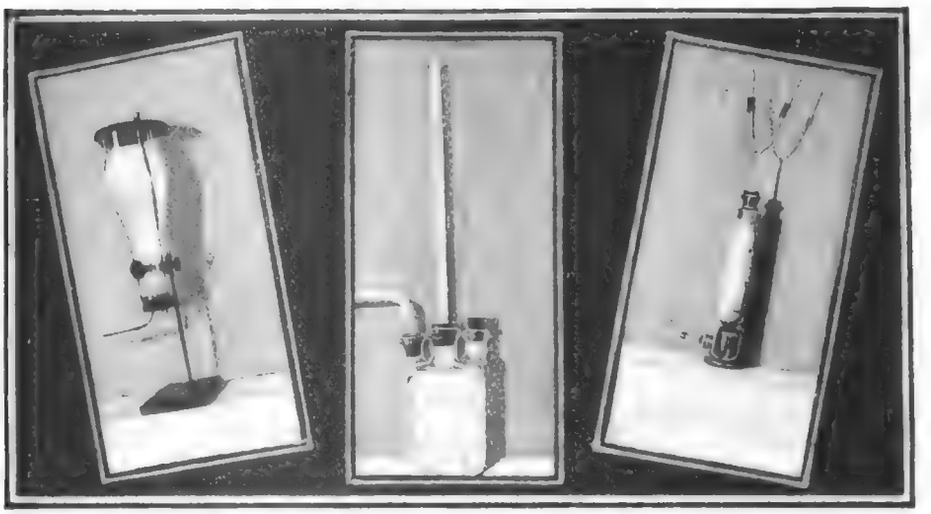
Practical Chemical Experiments

By RAYMOND B. WAILES

NO. 2, FLAME AND EXPLOSIONS; HOW THE STOVE BURNS AIR; LUMINOSITY OF FLAME DUE TO CARBON PARTICLES

IT has always been understood that gas or other similar flammable (burnable, often called "inflammable") substance requires air for its combustion. Gas (implying illuminating gas) will burn in air. Conversely, air will burn in gas.



1—(Left)—Air Will Burn in an Atmosphere of Gas. You Can Perform This Experiment With an Ordinary Lamp Chimney Covered with an Asbestos Board and Fitted with a Stopper and Tubes as Shown. 2—(Center)—Explosive Mixtures of Gas and Air Do Not Always Explode When Ignited. This Woulff Bottle Will Provide Many Harmless Explosions as Well as Being Instructive. 3—(Right)—That Gas Owes Its Luminosity to Particles of Carbon Can Be Shown by This Apparatus Made from Ordinary Laboratory Ware.

This is not hearsay, but can be proved by anyone willing to spare a few minutes in fitting up the lamp chimney arrangement as shown in Fig. 1. The lamp chimney is fitted with a cork at its smaller end (a cork large enough for the larger or bottom end might be difficult to procure) through which two glass tubes pass. One tube is bent to the left as shown and passes to the gas cock. The other tube is about ½" in diameter and four inches long. On covering the open end of the chimney with an asbestos card and passing gas through the bent tube, the air in the whole system will be displaced by gas. The gas issuing from the bottom of the larger tube is now lighted. On perforating the thin asbestos card the gas flame at the bottom of the large tube will be sucked up into the chimney and a peculiar flame will burn inside the chimney at the top of the larger glass tube inside the chimney. Apparently, the air coming in at the bottom of this large tube is burning in the interior of the chimney, or, air will burn in gas.

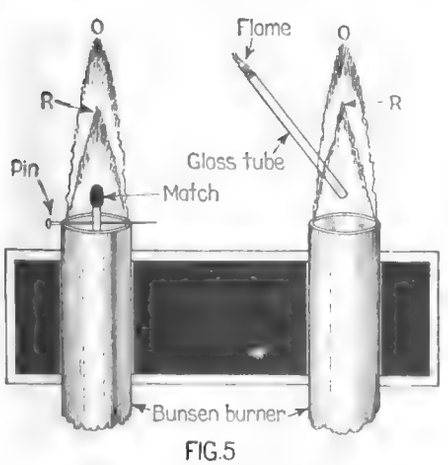


FIG.5

The Hottest Part of a Blue Flame is at the Tip of the Inner Cone, R, the Interior of This Inner Cone is Almost Stone Cold. A Match Thrust Thru the Head of a Pin and Supported on the Burner as Shown Will Readily Prove This.

All of the gas will not be consumed at this point, however, for if a flame is applied at the top of the chimney, the escaping gases will become ignited.

EXPLOSION MIXTURES DO NOT ALWAYS EXPLODE

Air mixed with gas in the proper proportions will form a mixture which is highly explosive.

This fact can readily be demonstrated with a Woulff bottle having three necks. (Fig. 2.) A wide mouth bottle fitted with a 3 hole cork stopper will serve as well. The gas is led into the bottle through the bent glass tube at the left, and with the cork inserted in the third tubuluture of the bottle, is lighted after half a minute at the top of the large glass tube which passes through the cork inserted into the middle neck. The gas will burn with a yellow flame. Now if the gas is shut off at the gas cock and the stopper in the right hand or third neck is quickly removed, air gradually passes in and mixes with the gas in the bottle. This produces a blue flame at the top of the large long tube, the blue becoming more pronounced as more air passes in and forms a more explosive mixture in the bottle. The flame finally become intense blue and slowly travels *down* the tube and into the bottle whence it ignites the explosive mixture within. The explosion is harmless, not breaking the bottle. The *combustion flame* was seen to travel down the tube while the *explosion flame* was seen as a mass of blue-white within the bottle.

CARBON PARTICLES MAKES FLAME LUMINOUS

The luminosity of carbon flame owes its luminosity to particles of solid free or uncombined, carbon in the gas, which particles becoming white hot by the flame temperature, emit light.

An instance of a flame due to ignition of a gas appears in the flame emitted by sodium compounds and compounds of many other substances when held in a blue or colorless flame. Table salt is a sodium compound (sodium chloride). Sodium bicarbonate or baking soda is another.

Hydrogen burns with a colorless or pale blue flame. If a stream of hydrogen, generated by the action of an acid such as hydrochloric on zinc, be allowed to pass through the apparatus in Fig. 3, a colorless flame will burn at the two tips or jets at the top. If the gas is now stopped and a small plug of absorbent cotton soaked in benzene or coal oil is put into the arm of one of the tips, and the gas is passed through again, the gas issuing from this tip will be highly luminous, owing to the presence of carbon particles (from the hydrocarbon) in the flame. The apparatus is a calcium chloride tower fitted with a Y tube, which is in turn fitted by rubber tubing, to the burning tips as shown.

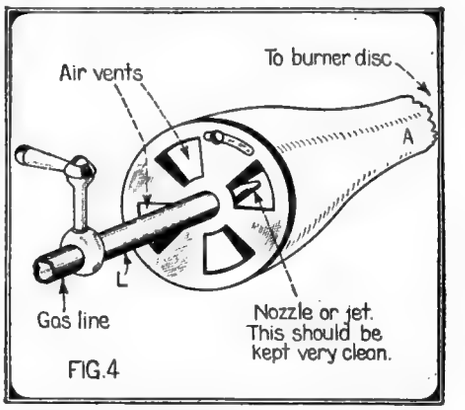


FIG.4

How the Kitchen Stove Burns Air. If the Cooking Utensils Become Coated with Soot on Their Bottoms, Pull the Burner A Out and With a Wire Clean the Small Hole or Jet at the End of the Gas Supply Tube. Replace Burner, A, Turn on Gas and Light Flame. Regulate the Shutters Until the Yellow Color of the Flame Entirely Disappears but the Flame Does Not Roar.

HOW THE KITCHEN STOVE BURNS AIR

A view of the working parts of the kitchen range burner is shown in Fig. 4. The gas entering the gas line L and issuing from the small hole at its end, or at the jet or nozzle end, causes the air within the chamber A to be pushed before it. As the air is being pushed, there must be something to fill the vacant place which it leaves behind. This vacant space or vacuum is filled with

(*Continued on page* 1219)

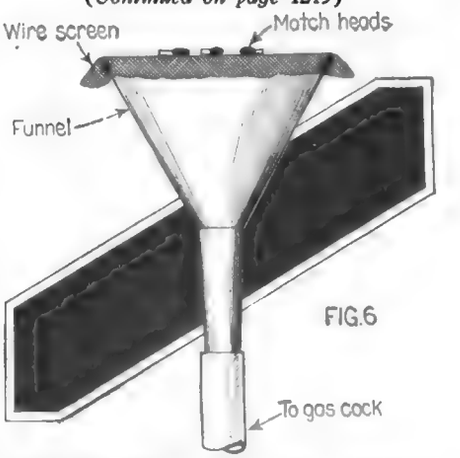


FIG.6

Interesting Experiment with Match Heads and Gas Flame

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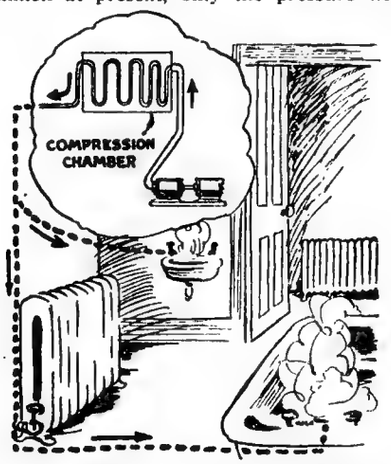
Scientific Problems and Puzzles

By ERNEST K. CHAPIN

NO. 7 OF A SERIES

A NEW HEATING SYSTEM

AN inventor plans, in a most ingenious way, to revolutionize all present systems of heating houses. Each house and building of the future, he declares, will be supplied with water from a central pumping station as is common at present, only the pressure will



Will the Inventor of This Device Become Rich From the Fruits of His Imagination?

be considerably higher. After entering a building the water will pass to a "friction chamber" consisting principally of many fine tubes through which the water will be forced with great velocity. The friction of the water against the pipes of the "friction chamber" will raise its temperature, whereupon the water will be conducted to hot water radiators throughout the building and to the bath and kitchen where hot water is desired for household purposes. In this manner, so the inventor claims, the energy developed at the power station can be transmitted to the consumer with little loss, converted directly into heat, and supplied whenever and however it is desired. It will be independent of time or season, supplying hot water the year around, eliminate to a large extent the smoke nuisance and the expense and bother of furnaces.

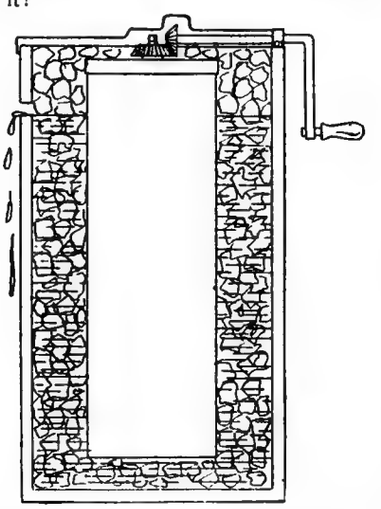
Do you consider the plan feasible?

HOW TO BREAK A BOTTLE

"You will observe," said the amateur entertainer, "that this extract bottle which I am passing around for your inspection, is filled with nothing but common drinking water secured by an ordinary cork stopper. Moreover the bottle is quite strong even if it is flat-sided. In fact it is so strong that I venture to offer a present of a much larger bottle filled with something far more substantial to the first gentleman in the audience who will break this one with his hands, applying his strength directly to the bottle, and without directing against it any manner of mechanical jar."

In vain did several men make the attempt with some risk, as they thought, of getting their hands cut. But their efforts were both useless and amusing. Then taking the bottle from their hands the entertainer turned the trick neatly and effectively. Although the effort which he applied was scarcely appreciable, the bottle cracked immediately and the water trickled out in mute witness to the genuineness of the feat. How did he do it?

P... ...ng This Problem That You Do ...nds When the Bottle Breaks.



Is the Manufacturer Correct in Placing the Overflow Hole of An Ice Cream Freezer in the Position Shown Above?

THE HOLE IN THE ICE CREAM FREEZER

Not a few house wives have insisted that the man of the house bore a hole near the bottom of the ice cream freezer to let the water out on account of the mistake which

Will the Man at the Front or Rear End of the Car Be Hit by the Bullet Fired by the Other Participant in This Duel?

the manufacturers obviously made in cutting it near the top. We have known of some who were foolish enough to follow this line of advice. But why were the manufacturers right in placing the hole where they did?

THE PROBLEM OF THE BULLET

Two men once got into a dispute while on board a train and finding themselves unable to settle the matter peaceably they decided to make an appeal to arms in the good old-fashioned way. Facing each other from opposite ends of the car, on a given signal from their seconds, they raised their pistols and fired. The shots rang out as one and each man fell dead in his tracks.

Some time later it occure dto the seconds who had witnessed the dual, to wonder

Suppose the Surface Upon Which You are Standing was Frictionless. Could you Move in Any Direction You Desire, or Would You Describe Gyrations Such as the Person in Our Illustration is Doing?

which man was hit first. They agreed that at the time that the fight was staged the train was traveling on a straight track at the rate of 60 miles an hour, that the windows and doors of the car were closed so that there was no breeze through the train, and that the weapons, which were of precisely the same caliber, had been discharged simultaneously. Which one do you think would be hit first, the man in the front or the man in the rear end of the car?

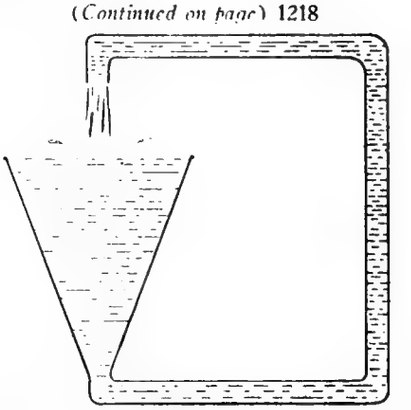
MOVEMENT ON A FRICTIONLESS SURFACE

If anyone questions the fact that friction is more of a help than a hinderance to mankind, let him imagine that he is standing upon a perfectly level and frictionless floor and he wants to get to some other spot. How could he do it?

PERPETUAL MOTION

In the accompanying diagram is shown a perpetual motion device the principle of which has been embodied in countless other schemes of equal merit. The greater weight of the water in the larger vessel is supposed to more than balance the weight of the water in the vertical tube which serves to return the fluid to its source again. Why will it not work?

(*Continued on page*) 1218



Here's Another "Perpetual Motion" Scheme. Will it Work?

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Experimental Electro-Chemistry

By RAYMOND B. WAILES

NO. 10 OF A SERIES

SODIUM amalgam, resembling from the chemical standpoint ammonium amalgam—that curious substance treated in the last paper—is formed by dissolving metallic sodium in mercury. Sodium metal is silver-like in appearance and

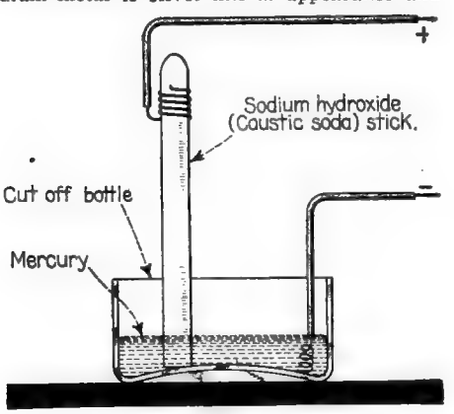

FIG.1

Sodium Amalgam May Be Prepared by Using Electrolysis Apparatus, as Shown in the Diagram Above. The Anode or Positive Electrode is a Stick of Sodium Hydroxide or Caustic Soda. It Should Be Wrapped at One End with a Copper Wire, Which is Nickel Plated, for Nickel Does Not React with the Sodium Hydroxide.

can be cut with a knife. It has a great affinity for water and is preserved under kerosene. When it is brought into contact with water it reacts forming sodium hydroxide (caustic soda) and hydrogen gas.

$$Na + H_2O = NaOH + H$$

The metal can be prepared quite conveniently, in the form of the sodium amalgam by using a simple electrolysis apparatus as shown in Fig. 1. Here a shallow dish, such as can be obtained by cutting the bottom off a small 1-oz. bottle, is filled with mercury and a wire is inserted into the mercury. This serves as the cathode. The anode or positive electrode should be a stick of dry sodium hydroxide or caustic soda. It should be wrapped at one end with a copper wire which is nickel plated, for nickel does not react with the sodium hydroxide, copper wire being attacked. This winding operation must be done quickly and the hands washed afterward.

On allowing several drops of water to fall down the sides of the caustic stick while the current is flowing between the two wires, the sodium of the sodium hydroxide will be attracted toward the mercury cathode and unite with it, forming the sodium amalgam. The current should run ten or fifteen minutes and then be stopped. The surface of the mercury should then be brushed with a sliver of blotting paper until dry. On adding water to the sodium amalgam and agitating, bubbles of hydrogen gas can be seen rising to the surface of the water. This is from the sodium reacting with the water as shown in the above equation. The mercury is not affected. A storage battery can be used for electrolyzing, or the 110-volt direct-current lighting system with several 60-watt lamps in parallel with one another and in series with the electrolysis apparatus can be used.

IODINE FROM POTASSIUM IODIDE

Potassium iodide is used extensively in medicine and photography. If a solution of this substance in water is electrolyzed in the apparatus, Fig. 2, copious clouds of iodine solution can be seen forming about the anode or positive wire.

Potassium iodide has the formula, KI (K meaning potassium and I iodine). When the solution is electrolyzed, the positive potassium ion is attracted toward the cathode or negative electrode and has its electrical charge neutralized, therefore becoming metallic potassium, which like sodium, reacts with water and forms hydrogen gas. This hydrogen gas can be seen coming from the cathode. The iodine will be attracted to the anode, lose its electrical charge—the charge of electricity which makes it an ion—and becomes elementary (without an electrical charge, free) iodine, which dissolves in the solution, turning it brown.

The brown clouds can be proved to be iodine by applying the starch test. A bit of iodine diluted with water when dropped into some starch water, or on a wet pealed potato, will cause the starch or potato (potato is mainly starch) to turn blue. A bit of starch dissolved in hot water, cooled, and added to the brown cloud will turn the liquid blue. The solution must not be hot.

SIMPLE ELECTROLYSIS CELL

A very simple and inexpensive cell with which electrolysis experiments can be performed is shown in Fig. 3. The bent ell tube is of glass and should be wide as possible (¾" diameter is excellent). It is supported by the tin or wooden slotted-piece as shown the tin being tacked to small wooden blocks. Pencil leads or battery carbons can be used as electrodes.

AN OZONE GENERATOR

Ozone is an allotrofic or modified form of oxygen. It is thought to be a molecule in which there is one more atom of oxygen than the molecule of oxygen has. Thus, O_2 is the symbol for oxygen, and O_3 the symbol for ozone.

The gas is in the air, but is more abundant at the seashores than in-land. It is a very powerful germicide and is used to purify water. It has a characteristic odor, unlike oxygen. It can often be detected, by its odor, around active electrical machines, such as motors, at the parts where sparking occurs, as at commutators.

A simple apparatus for the preparation of ozone is shown in Fig. 4. A glass Liebig's condenser is used. The outside shell or jacket of the condenser is wrapped with tinfoil, the foil being held on by bare copper wire, the copper wire also serving as a terminal which leads to the secondary of a spark coil. The inner tube is corked at one end, the cork being pierced by another wire which is connected with the other side of the secondary of the spark coil. The inner tube is filled with a dilute sulphuric acid solution in the proportion of about one part of acid to twenty parts of water by volume. The large end of the condenser is fitted with a thistle tube bent as shown, or the condenser can stand upright, thus avoiding the bend in the thistle tube. If the acid water

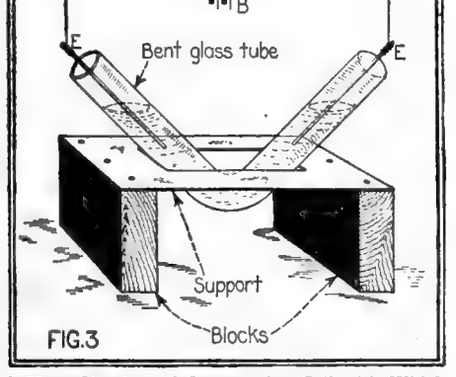

FIG.3

A Very Simple and Inexpensive Cell with Which Electrolysis Experiments Can Be Performed, is Shown in Fig. 3. The Bent Ell Tube is Made of Glass and Should Be as Wide as Possible. It is Supported by the Tin or Wooden Slotted Stand, While Pencil Leads or Battery Carbons Can Be Used as Electrodes.

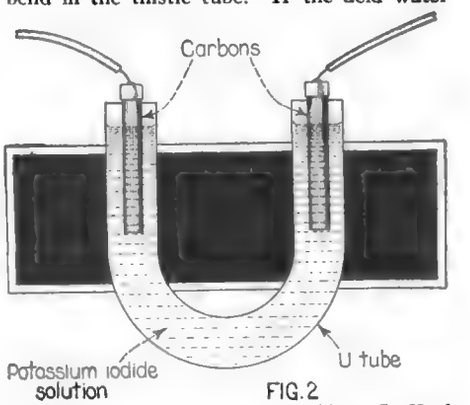

FIG.2

The Apparatus Shown in Fig. 2 Above Is Used in Water is Electrolyzed by the Current Passing Through the Solution, When Copious Clouds of Iodine Solutions Can Be Seen Forming About the Anode or Positive Wire.

should rise in temperature, it would expand. The thistle tube takes care of this expansion.

The whole apparatus is in reality an electrical condenser made from a Liebig's chemical condenser; the free inner space (which is normally occupied with water) serving as the air dielectric, and the tin foil and the acidulated water serving as the electrical conducting surfaces.

On starting the spark coil and allowing the current to jump the small gap, G, a stream of air kept flowing thru the condenser jacket, will be partly transformed into ozone. Ozone bleaches, and the issuing mixture of air and ozone will cause a discoloration of a very damp red flower if held in the stream for a length of time.

A supply of air for the experiment can be obtained from a large bottle fitted with a two-hole stopper with one long and one short glass tube. Water is introduced into the cone tube. The water displaces the air in the bottle, and if the remaining hole is fitted with a bent tube, the stream of air can readily be passed through the home-made ozone apparatus.

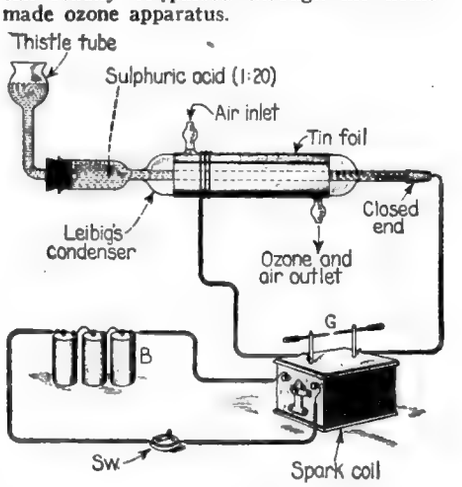

FIG.4

The Illustration Above Shows How to Make a Simple Ozone Generator, with the Aid of a Spark Coil and a Liebig Condenser. The Outer Shell of the Condenser is Wrapped with Tinfoil, While the Inner Chamber is Filled with a Sulphuric Acid Solution. The Air Passing Through the Outer Condenser Chamber when the Coil is Operating, Will Be Strongly Ozonized.

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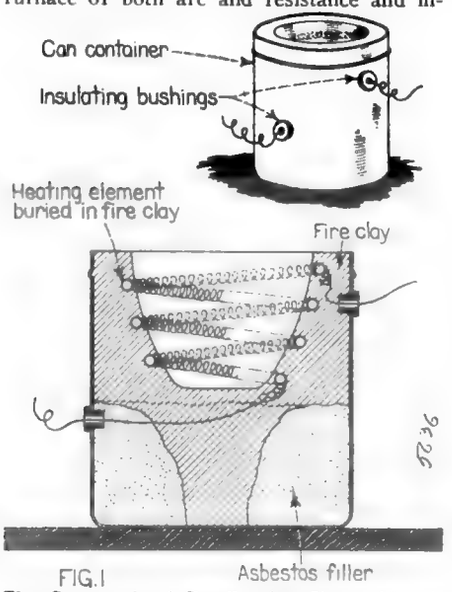
Laboratory Electric Furnaces

PERHAPS the greatest number of laboratory and shop processes are carried on with the aid of heat than with any other agent. The feeble heat of the candle, and the greater heats of the alcohol lamp, the Bunsen burner, the Mekker burner, the blast lamp, the electric furnace of both arc and resistance and in-



The Constructional Details of a Simple Electric Furnace Made From a Tin Can and Some Resistance Wire is Shown Above in Fig. 1.

duction types, are all adapted to their own particular uses.

Electric heating has many advantages over gas heating in the shop or laboratory, but generally we may consider that gas is the more appropriate and advantageous.

The chemist has to perform many heating processes where the sulphur and other products of combustion from the gas flame are detrimental to the processes carried out. Such is the case of coal, oil, food, and other analysis where the sulphur content is being determined by fusion with appropriate reagents. The sulphur in the gas causes high results in the analytical determinations. At other times, the presence of the carbon products of combustion in the flame are detrimental. As a source of heat in some organic or other typical chemical distillations, electric heating will be found to be more desirable than gas or Bunsen burner heating. It is true that the alloy resistance electric furnaces never reach the temperature of the air-gas blast, and that electric heating is a trifle more costly than gas heating. This article describes the construction of electric heaters such as are suitable for the above and other general processes and have been used by the author.

ELECTRIC HEATER FOR DISTILLATION

This electric heater or furnace, can produce temperatures up to 1,000 degrees Centigrade (1832° Fahr.). It is made as shown in Fig. 1, from a round tin can with a removable lid. Holes are punched through the sides as shown and portions of the smallest size of porcelain lead-in insulators are thrust through the holes. These portions should be cut off 1" from the large end of the insulator. The bottom of the can is strewn with loose asbestos to act as a filler. On top and in the center of this filler is thrust a mound of fire clay made into a plastic condition with water. When the furnace has been half way filled with asbestos and fireclay, the heating element should be inserted and coiled around, fireclay being packed into the coils with a spatula or flexible bladed knife.

The interior of the furnace, when completed should not show the resistance wire. It should be entirely covered with the fireclay. The furnace should be allowed to air-dry before use, although it can be cautiously brought up to its full heat expending a period of three or four hours for the first heat, or drying out.

WHAT KIND OF RESISTANCE WIRE TO USE

Patent restrictions prohibit the use of electrical resistances composed of an alloy of nickel and chromium metals, and now on the market to licensed users under the trade name "Nichrome." An alloy of silicon and chromium called "Silchrome" has been used by the writer with much success in electric furnaces and heaters. The wire can be purchased in the open market and is not subject to patent restrictions.

For the electric heater or furnace described above, about eleven or twelve feet of No. 20 B. and S. gauge Silchrome wire is necessary. The wire should be stretched in the air and a current passed through it —the 110 volt circuit being connected directly to the two free ends—until the wire has lost some of its brittleness. When cold, the whole length should be coiled upon a ¼" rod, making each turn come flush against the next one. The finished coil will now be about eight inches long, with the turns resting one beside each other, and consequently being electrically shorted. The length of coiled resistance wire should now be pulled out so that its length is about 14", without a single turn or coil touching its neighbor. This finished heating element is then twisted into position, after passing through one of the lead-in insulator portions in the side of the can, and is embedded in the fire-clay. More fire-clay is now added and the furnace built up until topped. Of course, other refractories such as Sil-O-Cel, Hytempite, etc., can be used instead of fireclay.

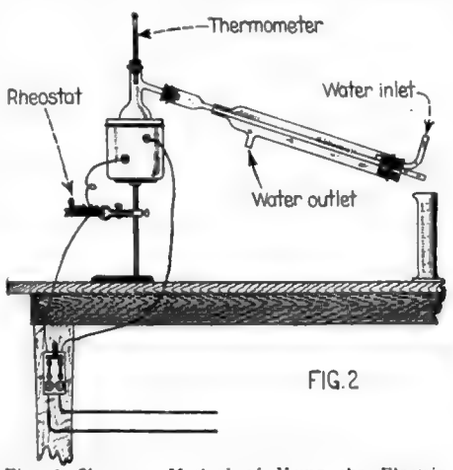
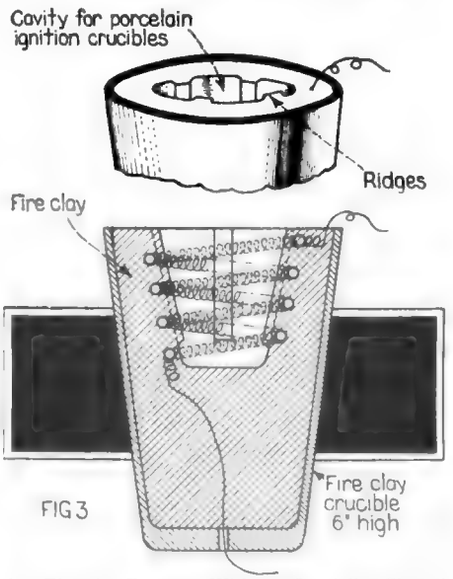


Fig. 2 Shows a Method of Using the Electric Furnace Illustrated in Fig. 1 for Distillation Purposes.

Fig. 2 shows the heater being used for a fractional distillation of oil. The body of the distilling flask rests snugly in the cavity of the heater. A rheostat made of the same wire can also be used in series with the furnace if desired. The furnace draws about 13 amperes on the 101 volt lines. The terminals are connected directly with the 110 volt mains through the wires affixed to the completed furnace.



An Electric Furnace With a Specially Shaped Cavity, for Use in Chemical Analysis is Shown in Cross-Section Above.

The same construction can be applied to produce another type of furnace much used in chemical analysis. It is shown diagrammatically in Fig. 3.

A fireclay crucible about 6" high is used for the container. A small hole is drilled through the bottom with the end of a three-cornered file. One end of the heating element passes up through this. The entire crucible is filled with the fireclay until half full, the heating element then being coiled around and held in final place by the application of more fireclay.

This furnace should have four little ridges on the interior of the cavity. These ridges are made with fireclay, and support the porcelain crucible which should fit snugly into the cavity and not project above same.

The completed electric ignition furnace is shown in Fig. 3. It is conveniently supported by a ring clamped to a ring stand. A porcelain crucible is used in the furnace.

The same length of resistance wire should be used for this furnace as for the can type. A small flower pot will serve as a container instead of the fireclay crucible. The furnace is operated directly across the 110 volt lighting circuit, A. C. or D. C.

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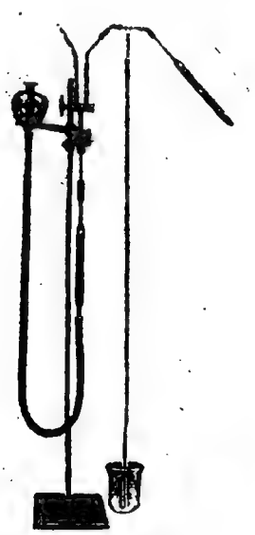
Production of High Vacua in the Laboratory

By RAYMOND B. WAILES

PART I.

MANY scientific achievements are the result of the successful application of methods for the production of high vacua. Radio in all its glory is in its glory because of the vacuum tube or audion which figures as the cardiac movement or heart beat in every



Photograph of vacuum pump used by the author, and corresponding to that shown diagrammatically in Fig. 2 at right. A vacuum is produced in a vessel connected to the exhausting tube, by repeatedly lowering and raising the mercury chamber, shown resting on support at left of pump.

modern receiver and transmitter. Vacuum tubes of all sorts and descriptions, amongst them being the X-ray, Plücker, Braun, spectrum, oscillograph, Geissler, high frequency, and many other types of tubes, all have, during their making, met and partaken of the friendship of a vacuum pump in one form or another.

There are many simple devices which give ample exhaustion of vessels which can in turn be used for countless experiments and the construction of practical devices by the experimenter. Several of the pumps described herein can be made with everyday laboratory apparatus, carefully fitted and heavily wired at the rubber joints to prevent leakage. A knowledge of glass working will come in handy when one is constructing his vacuum pumps. The sketches of finished pumps given herein are shown constructed of easily purchased parts. The more experienced experimenter can make glass-to-glass seals or welds wherever there is a rubber connection show. This step will materially reduce the leakage which is bound to occur with rubber connected or rubber assembled pumps.

The simplest type of vacuum pump is shown at figure 1. This is the well-known dropping mercury pump of Sprengel. It consists of a straight glass tube M, at least 32 inches long of the dimensions indicated, and connected with a T tube and funnel at the top. The funnel is filled with mercury and the screw clamp or pinchcock is slowly opened. Mercury trickles down the tube M, and in so doing, pushes little globules of air before it on its downward passage. The air globules are drawn in from the point X at the T tube. Since the vessel to be evacuated is connected with the tube as shown, the air is exhausted from this as the mercury drops through M. The black portions shown are rubber connectors made of rubber tubing Each connector should be wired on with iron wire and sealing wax dropped upon each connector, since mercury amalgamates with copper wire at each end. This operation must not end here, for the mere act of dropping on sealing wax will not effect a tight joint. The wax must be flowed over the joint as solder is sweated on work. This can be accomplished by contact with a heated strip of metal.

In operating this type of pump, the funnel should always be kept full of mercury, since air would rush into the vessel if this precaution were not taken. As the mercury flows into the beaker or other receptacle B, it can be syphoned or pipetted out and returned to the funnel for another downward passage. By this return passage, only a small amount of initial mercury is required for operating the pump.

As the vessel becomes exhausted, the mercury will fill the tube M, the excess flowing into the beaker. This tube M also serves as a manometer or an indicator of the degree of vacuum which is in the vessel or system. With a perfect vacuum in the system or vessel, V, the height from the top of the mercury in B to the top of the mercury column in M will equal the barometric height at the place of the instrument. With a high degree of exhaustion, normally, the height of the mercury column in M would be about 30 inches, but the length, 32 inches, is made so for high barometric pressures such as exist below sea level. A paper scale reading in inches or millimeters can be placed behind the manometer or fall tube M if desired. The whole apparatus should be mounted on a board. A shallow pan affixed to the base of the board in which the pump rests will serve admirably in mercury conservation in case of spillage or tube breakage.

OCCLUDED GASES

A vessel evacuated at room temperature will slowly show a rise in internal pressure, owing to the escape of gases occluded in the walls of the vessel. This gas slowly escaping, raises the pressure or lowers the vacuum of the vessel. Occluded gases may be removed from the vessel as it is being exhausted by gentle heating. This can be accomplished by placing an asbestos hood around the vessel to be exhausted and applying heat by means of a Bunsen burner. An asbestos shield S, figure 1, will keep the sealing wax cool at the connector. Care must be taken not to heat the vessel too hot, for as the pressure diminishes the walls

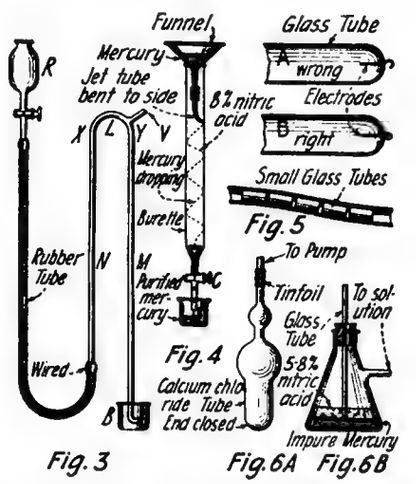
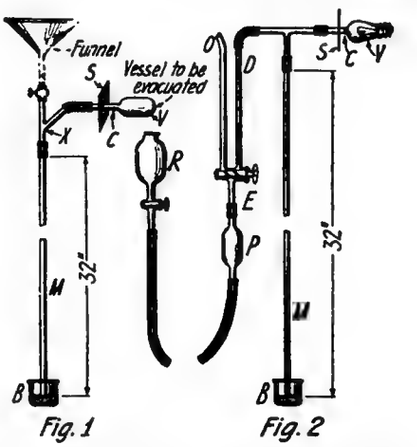


Fig. 3 above shows a Macleod vacuum pump. Fig. 4, purifying mercury; Figs. 5A and B, right and wrong methods of sealing in electrodes; Fig. 6A, simple violet ray tube, and Fig. 6B purifying mercury by bubbling air through it.

will tend to collapse should they become soft by application of a high heat. It is only with the aid of this heating process that a lasting vacuum will be produced in the tube or vessel desired.

Figure 2 gives a sketch of a simple vacuum pump which is capable of giving a high vacuum It consists of a three-way stopcock, O, a T tube, manometer tube



The simplest type of vacuum pump is that shown in Fig. 1 above. Mercury is allowed to drop down the vertical tube, pushing the air before it. Fig. 2 shows in detail the mercury vacuum pump illustrated in photo at left, with mercury chamber R to be raised and lowered until desired degree of exhaustion is obtained.

32 inches long and a filtering or a separatory funnel acting as a mercury reservoir, R. The whole set-up can be connected with tubing as shown. Glass-to-glass seals should be used if possible.

In operation, the stopcock is turned so that passage is made between E and O (which shuts off D). Mercury is poured into the reservoir, R, and R raised until the mercury rises above the stopcock, and enters tube O. The stopcock is then turned 180 degrees, thereby cutting off O and making communication between D and E. R is then lowered, and as the mercury falls in the tube P, it creates a vacuum above its level, or, pulls air from the vessel to be evacuated, V. Keeping R at the same low level, the stopcock is turned 180 degrees, making passage between O and E possible as at first, and the reservoir R is rasied until the mercury flows into tube O as before. The stopcock is then turned 180 degrees and the process repeated until the mercury, which is placed in beaker B, rises to the greatest possible height in the manometer tube M.

The chamber P can be cut from a 50 cc. pipette, or, a one-inch test tube can be connected at each end with glass tubes, by welding, using a pointed blowpipe flame. An ordinary funnel can be used instead of R, if the separatory type is not available. Because of the weight of mercury which the reservoir R and bulb P bears, the rubber tubing affixed to them should be heavily wired on. All connections should be smeared with sealing wax and the wax flowed on by application of a hot object.

MACLEOD VACUUM PUMP

This pump is similar to the Sprengel pump. It has the advantage over the Sprengel pump in that the mercury reservoir above the manometer or fall tube can be run dry without losing the vacuum. This accident with the Sprengel pump, is, of course, due solely to carelessness on the part of the operator.

(*Continued on page* 1219)

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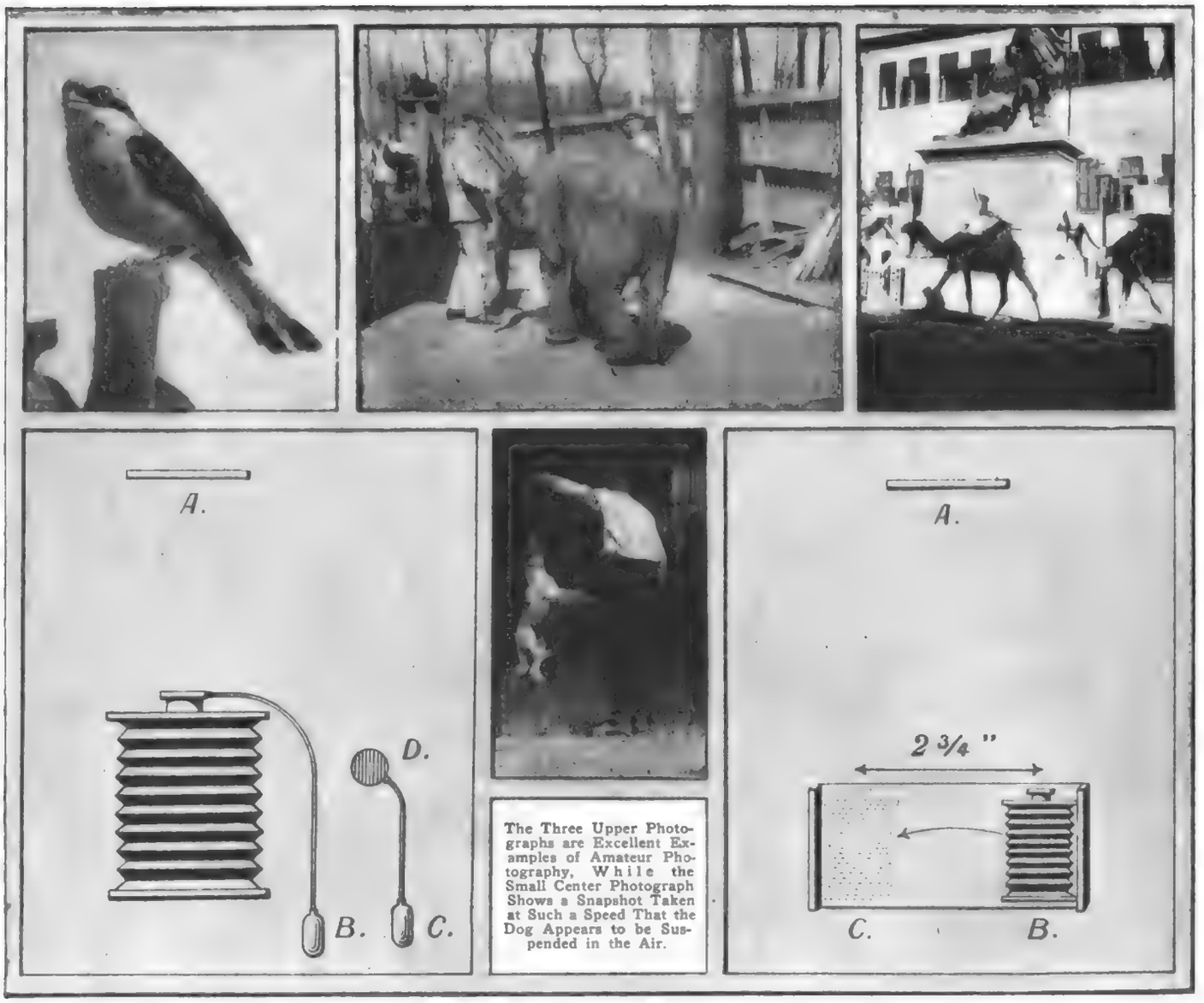
A.
D.
B.
C.
The Three Upper Photographs are Excellent Examples of Amateur Photography, While the Small Center Photograph Shows a Snapshot Taken at Such a Speed That the Dog Appears to be Suspended in the Air.
A.
2 3/4 "
C.
B.

In the Lower Left Hand Corner is Shown the Correct Arrangement for the Camera, the Subject, A, the Flashlight, D, and Its Release, C. The Camera Lens Should be Shielded from the Glare of the Flash by the Corner of the Camera. In the Lower Right Hand Corner is Shown a Method for Taking Stereoscopic Photographs by Shifting the Camera for Subsequent Exposures.

How to Use Your Camera

By Dr. ERNEST BADE

PART IV—SNAPSHOT AND FLASHLIGHT PHOTOGRAPHY

THE rapidity of the snapshot shutter is almost invariably rated far too high and the ordinary lens is not so well adapted for this purpose. It does not permit sufficient light to pass and does not illuminate the plate strongly enough for instantaneous photographs. All moving objects must be taken with such speed that they move less than 1/10 of a mm. (1/400 inch) on the ground glass, otherwise the pictures will be distorted. A moving object can be exposed for a greater fraction of time as the distance it is away from the camera increases, and as the angle of movement is less as referred to the axis of the camera lens.

It is for this reason that moving objects such as wagons, trains, runners, etc., are usually taken when they approach or depart from the camera. If they move parallel to it, only a very rapid shutter, an objective of large aperture permitting much light to pass, and an exceptionally sensitive emulsion on the plate, will give satisfactory sharp and clear cut pictures. The shutters of the majority of hand cameras fail under such rigorous conditions. As the camera approaches the moving object and as the direction of movement increases until the subject crosses the axis of the camera, the shorter must the exposure be.

For instance, a man approaching the camera and being distant 100 focal lengths must be exposed for 1/15 of a second. When the subject is twice this distance away, then *the plate* permits half of this time of exposure, that is, 1/30 of a second. A train in motion requires an exposure of 1/250 of a second at a distance of 100 focal lengths. These time requirements are maxima and should under no circumstances be increased, no matter how bad the lighting conditions may be. If such a rapid exposure becomes an impossibility, then the picture should not be taken.

Snapshots are only to be taken under the most favorable conditions. Direct sunlight is not essential; in fact, the contrasts between the light and the shadows are far too pronounced. It is more advantageous to take them when the sun is hidden by a few thin fleecy clouds, the differences between light and shadow being then more gradual. Snapshots must only be taken in the open, they cannot be taken under the canopy of the forest.

Ordinary street scenes require an exposure of approximately 1/20 of a second. Racing horses require a shutter speed of 1/100 of a second. The camera must, at all times, be held firm and immovable, the shutter being then released without shock.

It is important to test the speed of the snapshot shutter. Attach a bright object to the rim of a bicycle wheel and turn it at such speed that it makes one revolution per second. Take a picture of the revolving wheel after the shutter has been fixed at

(*Continued on page* 1243)

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Preparation of Cold Light Substances

MUCH has been said about the fascinating properties of cold light substances—substances which give off light unaccompanied by heat rays. But little has been given on the preparatio. of these cold light bodies, yet such substances giving many hues and colors can readily be made from the following formulas requiring only inexpensive ingredients.

Fluorescence is the property of a body in

Sulphur, an oyster shell and a crucible, are required for a simple cold light body. The luted crucible is shown here.

giving off visible radiations (light) when impinged upon by visible or invisible radiations, the light which is produced being prevalent only while the source of transformation is present. In other words, if the exciting source, such as sunlight, ultra-violet light, X-rays, cathode rays, etc., be removed, the cold light emitted by the substance will die out. Phosphorescence is embodied in a substance when the substance continues to emit the cold light after the exciting source has been removed. Most of the substances given here are both fluorescent and phosphorescent.

PHOSPHORESCENT CALCIUM SULPHIDE

This cold light body is made by heating powdered oyster shells to a red heat, cooling and removing the black particles. The white particles are then mixed with an equal part of flowers of sulphur and heated in a closed clay crucible with a fire clay top luted (cemented) on. The luted cover prevents loss of sulphur by oxidation. A red heat must be employed. Twenty minutes of firing at this heat gives a substance which will glow with a greenish-blue light or phosphorescence when exposed to bright sunlight, or ultra-violet rays formed from an iron spark.

The iron spark, as it may be called, is produced by a high tension discharge between iron points. A spark coil and an iron spark gap serve admirably. They are connected as shown in the figure. An X-ray tube can be substituted for the iron spark if desired, although some of the preparations do not exhibit luminescence under their action.

Natural zinc silicate, or willemite, which is found at Franklin Furnace, N. J., fluoresces and phosphoresces under the action of the ultra-violet rays which are given off by the iron spark. The following formula can be used to make an artificial zinc silicate:

Zinc oxide.....100 parts by weight
Silicic acid..... 50 parts by weight
Manganese dioxide ..... 0.5 parts by weight

All of the substances used for this formula should be chemically pure. They should be finely ground and intimately mixed; the heating or other procedures must be followed closely.

The above ingredients should be heated in a porcelain crucible and heated until the mass becomes white, and held at this heat for half an hour. It should be white when cold; if not, it should be ground up and heated again.

The small amount of manganese dioxide in this as well as other formulas serve to adulterate the main body. It is this adulteration which is responsible for the cold light properties. The impurities are included naturally in the mineral willemite. The substance gives a green light when exposed to the rays described above.

TRIBO-LUMINESCENT SPHALERITE

Certain varieties of sphalerite, a zinc sulphide mineral, will show tribo-luminescent or mechanical light-producing properties when struck by a hard object. The artificial variety giving a yellow fluorescence but practically no phosphorescence is made from:

Zinc carbonate.....50 parts by weight
Flowers of sulphur.15 parts by weight
Manganese dioxide. 0.25 parts by weight

The zinc carbonate can be made by adding a solution of sodium carbonate to any zinc salt in solution. The precipitate of zinc carbonate should then be filtered, washed and dried. It decomposes into the oxide when heated, as in the above formula.

If a card be taken and coated over with gum Arabic solution, and the prepared tribo-luminescent zinc sulphide, or sphalerite, be sifted on and dried, a stream of scintillations will be produced when a hard object is drawn across the coated card. The substance does not fluoresce or phosphoresce under the action of the iron spark.

FLUORESCENT AND PHOSPHORESCENT ANHYDROUS CADMIUM SULPHATE

This salt must be preserved in tightly stoppered bottles. Fifty parts by weight of cadmium sulphate and 0.1 part of manganese sulphate or chloride are dissolved in water. Evaporate in an evaporating dish carefully, then powder the resulting mass and heat in a porcelain crucible at a red heat for half an hour. When cold, bottle. The heat should be a dull red, never bright red. The compound gives a pink fluorescence under the action of the rays from the iron spark A bright yellow phosphorescence, rapidly dying out can also be observed. If moisture is absorbed, due to constant exposure to the atmosphere, the substance will no longer show luminescence. It can then be calcined again.

A zinc sulphate gives a pink fluorescence under the iron spark. It is made exactly as in the preceding preparation, zinc sulphate being substituted for the cadmium sulphate. Like the preceding preparation, it does not respond to X-rays.

A FLUORESCENT CADMIUM PHOSPHATE PAINT

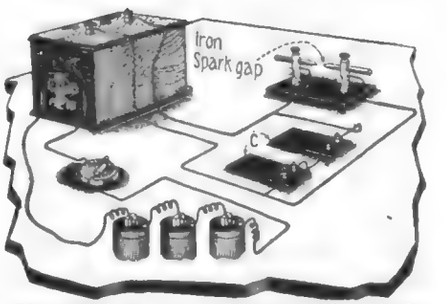
This substance can be mixed with a gum Arabic solution, obtained by dissolving gum Arabic in hot water, and applied as a paint.

The substance gives a red fluorescence when exposed to the ultra-violet rays emanating from the iron spark. When the iron spark is cut off, a red phosphorescence persists for a short period.

Manganese dioxide... 1 part by weight
Cadmium phosphate (neutral) .....60 parts by weight

The above should be heated in a porcelain crucible until the cadmium phosphate melts and the black manganese dioxide dissolves in this melt. The heating should then be continued about 15 minutes, the crucible removed and the liquid contents poured upon a sheet of slate or porcelain. The resulting cold mass is fluorescent cadmium phosphate.

The cadmium phosphate used can be obtained by adding neutral sodium phosphate solution to a cadmium salt in solution, filtering and washing the resulting precipitate.



The radiations from an "iron spark" are rich in short rays which cause the luminescence in the compounds described in this article. Iron rods are inserted in an ordinary spark gap for the production of these rays.

LUMINESCENT ZINC-CADMIUM PHOSPHATE

This compound is identical with the preceding, excepting that an additional 60 parts of zinc phosphate are added, the melting being performed as before.

The fluorescence which this double compound produces is of a lighter shade of red than the cadmium phosphate. Its phosphorescence also lasts a trifle longer than the preceding.

The zinc phosphate is also prepared in the same manner as the cadmium phosphate, a zinc salt in solution being precipitated with the sodium phosphate.

It must be remembered in experimenting, that the majority of the invisible ultra-violet radiations which cause luminescence in the different materials will not pass through glass. The amount that does pass through glass is insignificant. Substances should, therefore, not be *insolated* or exposed to the radiations while still in their glass containers. They should be poured out on a watch glass or white card, the rays being directed upon them from above.

Vast wealth for those who get there first was described recently by Prof. Lacroix at the Academie des Sciences. Madagascar, he declared, is capable of producing quantities of radium, and mining rights are staked out as in the days of the California gold rush.

French colonists, investigating the island's minerals, discovered the radium, he says. Natives were employed to dig the red earth, which contains a considerable proportion of pitchblende. Analysis shows one gram of radium bromide can be extracted from ten tons of earth, Prof. Lacroix declared. He estimates the new production at the present rate will double the present output.

A plant near Antwerp which extracts radium from ore recently discovered in the Belgian Congo, has so improved its methods that the American producing companies controlling the works have decided upon a shutdown, says a Brussels dispatch to the *Matin*.

Soon after the discovery of the rich deposits of Congo ore the price of radium declined to $70,000 a gram. It [illegible] averaged $107,000.

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HOW-TO-MAKE-IT

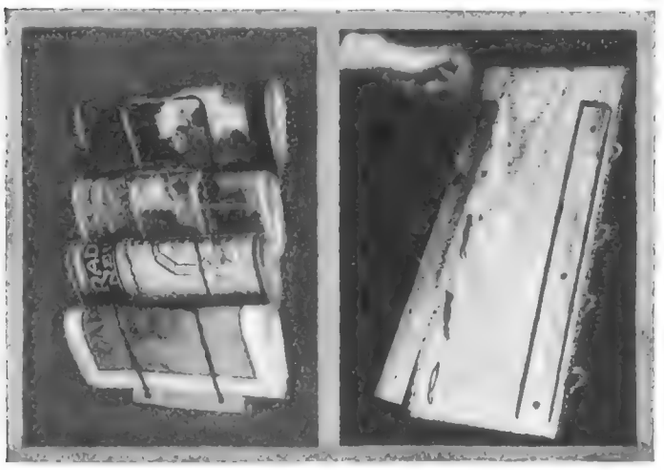
This department will award the following monthly prizes: First prize, $15.00; second prize, $10.00; third prize, $5.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $15.00 is awarded; for the second best idea a $10.00 prize, and for the third best a prize of $5.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $15.00

A SIMPLE MAGAZINE RACK

It is a nuisance to have a lot of magazines scattered about the house. They are not only in the way, but if a particular one is sought, it generally cannot be found. To overcome this unpleasant condition is comparatively simple; all that is required is a board and some stiff wire. Make the board of any convenient size and bore holes near the edges through which the wire is later passed. Their number depends upon the size of the board and the number of periodicals to be laced in it. The wire, which must be stiff, can be of any suitable material as long as it is of the requisite length. Bend it in the form of a broad letter U. Pass the ends of the wire through the holes and bend the projecting ends, which should be at least two inches in length, upward. Now take two strips of wood and screw it in place over the bent wire. This will hold it firmly. Now hang it up against the wall and put the current numbers on top and the older ones on the bottom shelf.

Contributed by E. BADE.



A Magazine Rack Which Will Keep Each One in its Place and Still be Convenient, is Shown on the Left.

SECOND PRIZE $10.00

HANDY LETTER SCALE MADE FROM DESK RULER

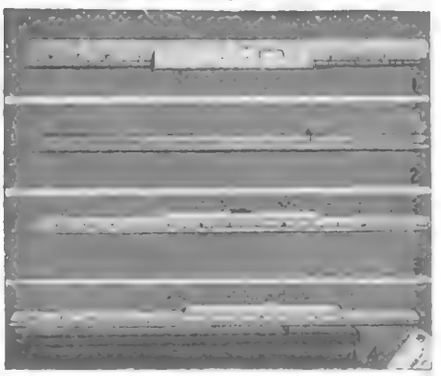
By the use of a bit of wire and a strip of lead or other metal one may, without taking away any of its convenience or usefulness, convert his desk ruler into a letter scale that is both handy and absolutely accurate. The only tools needed are a pocket knife, a file, and a common awl. Here is how I made one that I use constantly.

As I already had a fifteen-inch ruler that was about one-fourth-inch thick, I proceeded to adapt it to my operation. First I filled a small paper bag with what I knew to be in excess of ten ounces of sand, and took it over to the drug store. I got the druggist to weigh this into packages, which, including the paper and string, weighed respectively 1, 2, 3 and 4 ounces, troy weight. Then I stopped in at the printer's and got two twelve-point linotype slugs, which, placed end to end, were almost six inches long. Then I was ready for my construction work.

First I beveled off the end of one slug, using my pocket knife to do this, and smoothed it up with the file. Then I glued a strip of cardboard on each side of the slugs, to hold them together. Next I took a piece of wire 1¾ inches long, and formed it into the shape of a flat staple, with ⅞-inch top, and sides ⅞ of an inch. This staple may be seen in one of the illustrations, Fig. 1, which also shows the other two parts—the ruler and the slug. Next make two holes in the back of the ruler at the center, each a fraction of an inch from the edges, and five inches away from the end of the ruler, in other words, at the five-inch marking, being careful to make them ¼ inch deep and spacing them so that the staple would fit in snugly. This staple can be made of an ordinary wire clip of the type shown holding the letter in one of the illustrations. When this clip is placed in these holes it forms the fulcrum on which the ruler rests while an object is being weighed; see Fig. 2.

In order that there might be no danger that the slug and the staple would be mislaid, I made provision for attaching them to the top of the ruler when it was in ordinary use. This was done by boring two holes in the top of the ruler in the center, and boring two holes through the slug, also in its center. Both sets of holes, of course, are spaced to admit the staple. As shown in Fig. 3, the slug may be fastened to the top of the ruler by means of the staple, and without detaching them it may be used for ordinary purposes.

(*Continued on page* 1243)

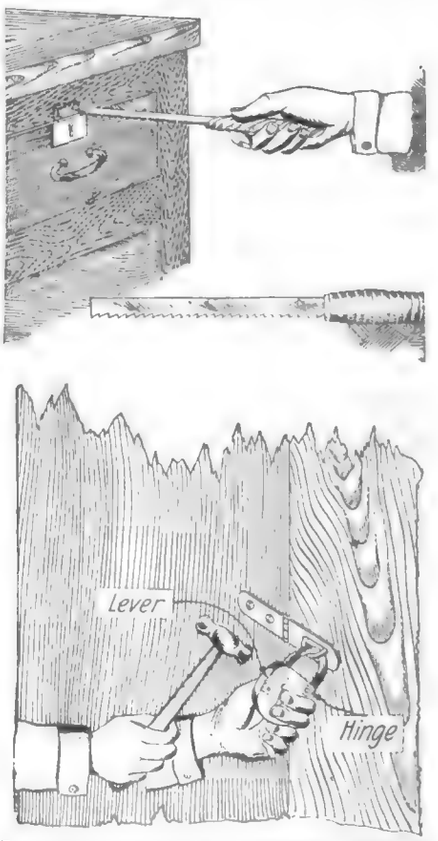


A Scale to be Used For Weighing Letters and Made From an Ordinary Desk Ruler is Shown Above.

THIRD PRIZE $5.00

SHORT CUTS IN UNLOCKING LOCKS

When the desk drawer or wardrobe key is lost, the usual method is to jimmy the door or drawer open. The result is scarred and splintered woodwork and a perfectly good piece of expensive furniture is spoiled. The better method is to use a short hacksaw blade and twist a rag over one end as a handle. Place this in the slit above the edge of the drawer and saw the latch lip off. While this destroys the lock, the woodwork is uninjured.



Two Methods of Opening Different Kinds of Locks When the Keys Are Lost Are Illustrated Above.

With the usual padlock a method which is common is to open the lock by rapping it. As an explanation of this the lock is held edgewise in the palm of the left hand, the hinge of the latching hasp down. A hammer, pliers or other tool is swung to strike a light, sharp blow on the opposite side of the hinge, and the hatch will fly open. As an explanation, the pawls which act as catches are supported by very light springs, which, when struck a short, snappy blow, fly back and the hinged hasp is free to open.

This method does injure the lock. Some higher priced locks will not respond to this treatment and if you are uncertain about the protection your locks afford, try them out with this test.

Contributed by G. A. LUERS.

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Wrinkles, Recipes Formulas

EDITED BY S. GERNSBACK

THIS MONTHS $5.00 PRIZE

LUMINOUS CHEMICAL MIXTURES

Everyone knows that a certain form of zinc-sulphide possesses certain peculiar properties, whereby when the zinc sulphide is acted upon by daylight, sunlight, electric light or gaslight, the surface will seem to absorb a certain amount of light and will radiate it back. One can observe this phenomenon when, after exposure to light, you put the phosphorescent zinc-sulphide in a dark room. By special process it has been possible to obtain at least three kinds of phosphorescent zinc sulphide: yellow, orange and green. On the stage these produce splendid artistic effects. It is possible to make these phosphorescent chemical compounds quite cheaply. The following five formulas will give a scale of five colors, which will enable any amateur chemist to paint small phosphorescent pictures, which when exhibited will astonish his friends.

1.—To obtain a blue phosphorescent compound, mix together:

Lime	20 grams
Sulphur	6 "
Barium Sulphate	20 "
Potassium Sulphate	1 "
Sodium Sulphate	1 "
Starch	2 "
Lithium Carbonate	2 "

and add:

2 cc. of a solution of: 0.5 Gram Bismuth Nitrate dissolved in 100 grams water, and

2 cc. of a solution of: 1 gram Rubidium Nitrate in 100 grams water.

2.—To obtain a violet phosphorescent compound, mix together:

Lime	20 grams
Sulphur	6 "
Starch	2 "
Sodium Sulphate	0.5 "
Potassium Sulphate	0.5 "

and add:

2 cc. of a solution of: 0.5 gram Potassium Nitrate in 100 grams of Alcohol,

½ cc. of a solution of: 0.5 gram Thallium Sulphate for 100 grams water and a few drops of Sulphuric Acid.

3.—To obtain a yellow phosphorescent compound, mix together:

Sodium Carbonate	100 grams
Sulphur	100 "
Magnesium Chloride	0.4 "
Sodium Chloride	0.5 "
Potassium Chloride	0.5 "

4.—To obtain a green phosphorescent product, mix together:

Sulphur	6 grams
Sodium Carbonate	40 "
Arsenic Sulphide	1 "
Lithium Carbonate	1 "

and triturate with: 2 cc. of a solution of 0.5 gram Thallium Nitrate in 100 grams water.

5.—To obtain an orange phosphorescent product, mix together:

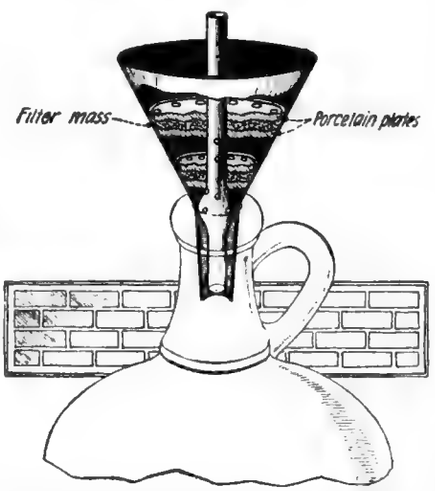
Sulphur	6 grams
Barium Carbonate	40 "
Lithium Carbonate	1 "
Rubidium Carbonate	0.46 "

All the formulas are to be made up with powdered chemicals and the mixtures must be heated to a white heat for some hours.

Contributed by CHARLES MOHR.

RAPID FILTERING APPARATUS

A liquid filter that filters liquids nearly as rapidly as the free funnel itself has recently found its place upon the American market. This filter comprises a glass funnel with a side pitch of 60 degrees, which funnel is 8 inches in diameter. Four perforated disks made of porcelain, non-absorbent and acid-proof, are furnished with the outfit. These fit into the funnel in two groups of two's. Between both the lower and upper sets is a filter mass made in the form of a heavy specially-prepared paper which has recently come from Germany. This mass appears to be heavy blotting paper, highly compressed. A glass tube passes through the center of the filter paper and through the two sets of porcelain disks, and by virtue of small vents, permits the air in the center cavities to pass out easily, thus eliminating any vacuous reverse action which the filter may produce. Perfect filtration is possible, which occurs in less than one-tenth of the time required by ordinary filters.



A Simple, Rapid Method of Filtering Liquids in One Tenth of the Usual Time is Illustrated Above.

WASTED PRINT

It is not generally known that the eyes in reading only see just the top of each letter in a line of type. This is easily verified by covering up the bottom half of a line as in figure 1. It can be read without any difficulty. In figure 2 the top half is absent and the wording is only understood after conscious thinking.

It would thus be possible to more than double the capacity of a magazine by omitting the unnecessary base of the type letters.

Contributed by W. A. REM

WASTED PRINT

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Contributed by W. A. REM

REMOVING RUST FROM STEEL TOOLS

Steel tools, such as squares, rules, etc. that are graduated in inches and fractions of an inch, soon acquire a slight coating of rust which makes it difficult to read their markings. The usual method adopted by most persons is to brighten them with emery cloth, which has the drawback that as their graduations are not very deep, the scouring that they receive will destroy the tool in time. As an "ounce of prevention is better than a pound of cure," it is better to remove the rust by chemical means, instead of using emery cloth. Get a quart of distilled water at any drug store, and dissolve in it little by little, sufficient chloride of tin (also obtained from a druggist), shaking vigorously and adding more chloride until the water will not dissolve any more of the salts, thus forming what is called a saturated solution. Then put some of the liquid in a dish and after cleaning the rule thoroughly, put it into your tin solution and allow it to remain over night or until it turns white. Rinse it off by holding the rule under running water; dry with a cloth and it will have a silvery white color, in fact, it will have a coating of tin. Prevent further rusting by slightly greasing it with a rag dipped in vaseline. Don't use oil on the rag, as most oils contain traces of acids which blacken steel tools.

To remove ink stains from cloth, treat the stain with the tin chloride and follow with oxalic acid solution. Repeating necessary.

Contributed by W. S. STANDIFORD.

USE SALT TO BRIGHTEN WELSBACH MANTLES

When Welsbach mantles used for gas, kerosene and gasoline lighting systems become blackened with soot, as these sometimes do, because the means of regulating the quantity of air for proper combustion of the gas is improperly adjusted, the mantles, having been in use for a period of time, do not conclude that because they are black they are of no further use, but try this remedy. With the light still burning, and after the mantle has been thoroughly heated up, sprinkle some fine salt on it. This becomes effective almost immediately, and in a few minutes it will be found that the salt has entirely removed the soot and the mantle is practically as good as new. This treatment can be applied each time the mantle blackens up without any detrimental effect.

Contributed by G. A. LUERS.

BURNING ICE

The phenomenon of a piece of ice burning is a very interesting one and can easily be performed. A small amount of ether is added to water in a test tube and both substances thoroughly shaken together. The water will dissolve some of the ether. The solution is then immersed in a freezing mixture of ice or snow and common salt until it is entirely frozen. The solid mass can be removed by slightly heating the test tube by dipping it in warm water. If this rod of ice is made to stand up on one end and lighted it will begin to burn and continue to burn until the ice is melted. In this striking manner one can show the solvent action of water upon ether.

Contributed by F. C. HENDI

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RADIO DEPARTMENT

A Simple DX Broadcast Receiver and Amplifier

THE tendency of the manufacturers of various radio receiving apparatus, seems to be in general towards more controls rather than towards simplicity. This is considered necessary in order to attain a maximum degree of selectivity, and freedom from interference. However, a New York manufacturer has designed and developed a radio receiving set, which aside from the two rheostats, has but one tuning control. This set is illustrated herewith, and a wiring diagram of the same is also given.

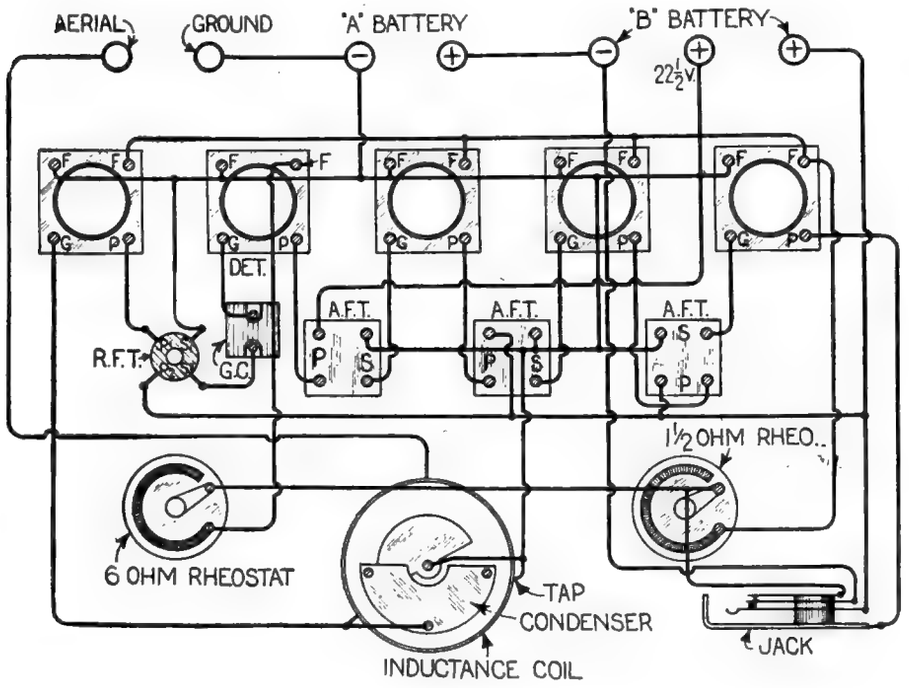
The set utilizes five tubes mounted on the top of a formica panel 15 inches long by 12 inches wide, giving one stage of radio frequency amplification, a detector and three stages of audio frequency amplification, the resulting current is sufficient to operate a loud-speaker.

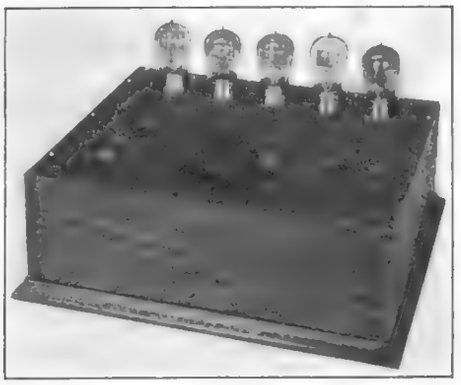
The tuner used in connection with this set is unique in that it uses a single inductance coil tapped in the center, and a variable condenser, the variation of the latter being the only tuning control. But two rheostats are used, one controlling the current supplied to the filament of the detector tube, and the other controlling the current supplied to the amplifying tubes. The latter rheostat has a resistance of 1½ ohms in order to pass the necessary current. Three standard audio frequency transformers are employed, and a mica dielectric grid condenser is supplied. The radio frequency transformer is specially designed by the manufacturers to respond to the range of wave-lengths covered by the tuner in the set or about 200 to 600 meters. This transformer is of the air core type, with two windings.

This set is furnished by the manufacturers completely assembled, either wired or unwired. The amateur can save almost 50 per cent in the purchase price by buying this set unwired and doing this work himself. With the instructions furnished by the makers, the latter becomes an extremely simply proposition. With the set is supplied a wiring diagram showing exactly how each connection is to be made, and each wire supplied is numbered. The instruments as indicated in this diagram are in actual relation to each other in the same way as they are mounted on the back of the panel. Accompanying the wiring diagram is an instruction sheet telling just how each wire is to be placed and just where connections are to be made and soldered. The numbers on the wires correspond with numbers on the instruction sheet, and a person does not even have to have an elementary knowledge of electrical wiring to hook up this set completely and to make it work. The manufacturers suggest that, as each connection is made on the set, the corresponding connection on the wiring diagram be checked off with pen or pencil, so that when the wiring is finished, the constructor can at once glance at the diagram and make sure whether or not each wire is connected.

A filament control jack is supplied and is so connected that when the plug is inserted therein, all the filaments will light, and when it is withdrawn, the current will be cut off from them all.

Although this circuit is non-regenerative, still, it gives excellent results when used with either an outdoor antenna or a loop. In the latter case the wiring is changed somewhat, and the variable condenser is connected directly across the loop, leads going therefrom to the radio frequency amplifying tube. When in use in the offices of the manufacturer, and connected to an outdoor antenna, there is no trouble experienced in tuning out nearby broadcasting stations, and bringing in the more distant ones. This set has been tested, and proved its superiority, Chicago and other long distance points having been received in New York City on a loop antenna. At a recent radio show in New York City, this set was used with a loop in a large steel frame building. Even under this handicap no trouble was experienced in reception.





The Completed Set Described in the Text is Shown Above. It is Unique in its Construction as the Tubes are Mounted in an Upright Position on the Cabinet. As Will be Noticed, Only One Tuning Control is Used.

To the Left Is Shown the Extremely Simple Hook-up of the Five Tube Receiving Set Illustrated Above. A Diagram Similar to This One is Furnished With Each Set and Every Individual Connection is Numbered Thereon. Accompanying This Diagram is an Instruction Sheet, Telling Just How Each Separate Wire is to be Fastened. With This Information the Person Connecting the Set Cannot Possibly go Wrong.

The one thing that recommends this set to the radio fan is the fact that in order to wire up the same, he needs no knowledge of radio symbols or circuits. The circuit supplied is exactly the same as that used in connecting up the manufactured instrument, and has been tried out and found to be successful. This set is furnished complete with the exception of tubes, batteries and head phones, which latter can be purchased by the owner to suit his own particular taste. Any standard tubes will function properly in this circuit, one detector and four amplifiers being necessary. The "B" battery voltage can be from 60 to 150 or even more with a tap at 22½ volts, which is used to supply the proper potential to the plate of the detector tube. A 6-volt, 80 ampere hour storage battery, may be used to supply the filament current to the tubes; the larger the battery, the longer it will last.

It is not advisable to use the new dry cell tubes in this circuit, inasmuch as they are not adapted to radio frequency amplification.

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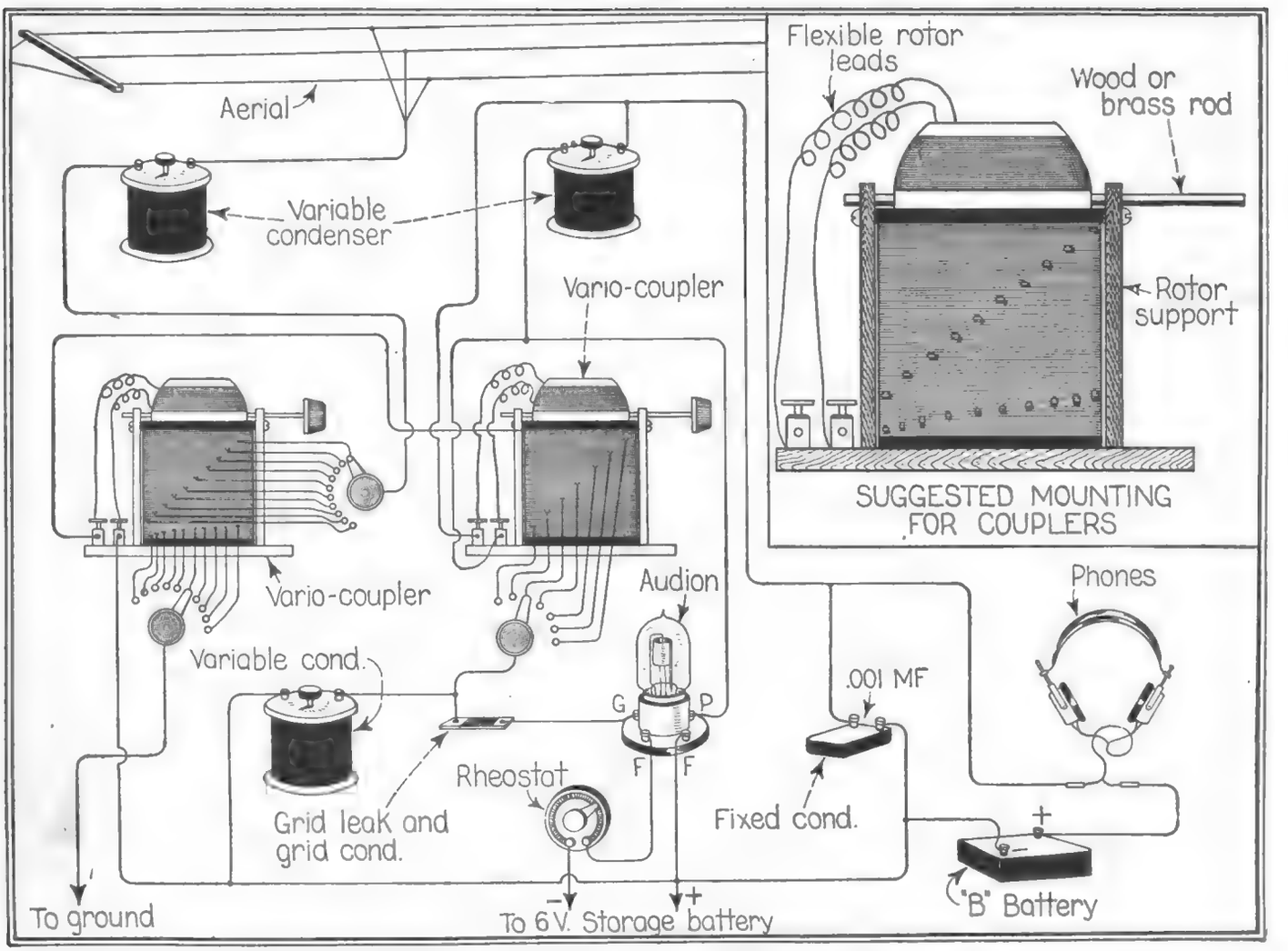

A Tuner Which Will Give Excellent Results for Short Wave Reception, is Shown Above. The Constructional Details of the Couplers Are Shown in the Upper Right Hand Corner, and the Data for the Windings is Given in the Text. Any Number of Stages of Audio Frequency Amplification Can Be Added to This Circuit in the Standard Way.

Ultra-Selective Short Wave Tuner

By A. P. PECK

MANY amateurs who are now using regenerative tuners consisting of a vario-coupler and employing the rotor as a tickler coil, have considerable trouble in securing proper regeneration and oscillation. In many such cases, it is impossible to make the detector tube oscillate over the entire wavelength range. If, however, they will take the trouble to build a set following the description given below, they will find that all their troubles will vanish and that the tuning of their sets will be wonderfully selective and comparatively free from body capacity.

Three variable condensers are necessary for the proper action of this set, although the one in series with the antenna may be eliminated with not a great deal of reduction in efficiency, provided that the vario-coupler whose primary is in series with the antenna and ground, is tapped in both units and tens.

We will not attempt to deal with the construction of variable condensers in this article, as in this era of radio they or the parts can be purchased quite cheaply.

The condenser in series with the antenna, if one is used, should have a maximum capacity of .001 M.F. The one across the primary of the second vario-coupler and the secondary of the first coupler, may have a maximum capacity of from .0005 to .001 M.F., the exact value being practically immaterial. The condenser in shunt with the tickler coil should have a maximum capacity of .0005 M.F., and should preferably be provided with some sort of vernier attachment. Verniers will also be found advantageous when used on condensers across the rotors of the couplers.

The first, or tuning vario-coupler, may be of standard make capable of tuning to 500 meters or thereabouts, or may be constructed as follows: The primary consists of a bakelite or heavy cardboard tube 4 inches in diameter by 4 inches high. This is wound with 91 turns of No. 22 single cotton or silk insulated wire. Taps are taken off every 9 turns for 81 turns, and then every single turn to the end of the winding. The secondary should preferably be wound on a ball form such as may be purchased for a small sum from any radio dealer, and it should be 3½ inches in diameter. If it is found impossible to procure such a ball, a tube 3 inches in diameter by 2¼ inches wide may be used. A space ¼ of an inch wide is marked off around the circumference of this tube. This is to allow for the shaft used in turning the rotor. 40 turns of No. 24 single cotton or silk covered wire are now wound on each side of this space, making a total of 80 turns. Care should be taken to wind both halves in the same direction. If a ball is used, it will be found that this space is already provided for.

These two coils are now assembled as shown by the use of two uprights, and connections are brought out from the rotor by means of flexible leads. Be sure to see that the windings on both the stator and rotor run in the same direction. Various methods of mounting and connecting the rotor will suggest themselves to the amateur, which will best lend themselves to the material he may have on hand.

The second or feed-back coupler has the same diameter primary, but the length is 3 inches. This is wound with 70 turns of No. 22 single cotton or silk covered wire, tapped every 10 turns. The secondary of this coupler is wound on the same sized tube or ball as the one above described, but the winding is composed of 60 turns of No. 24 wire. It will be best to experiment with the winding of this latter coil somewhat in order to determine exactly what number of turns give the best results in connection with the particular tube and condensers being used.

In tuning, the rotor of the tickler coupler should be placed at minimum or perpendicular to the base. The tickler condenser should be placed at maximum, the secondary condenser at maximum, and the primary circuit of the tuning coupler varied until signals are heard. It may be found necessary also to vary the inductance switch on the primary of the tickler coupler, and also the secondary condenser. When signals are heard the circuits may be balanced until maximum regeneration is obtained.

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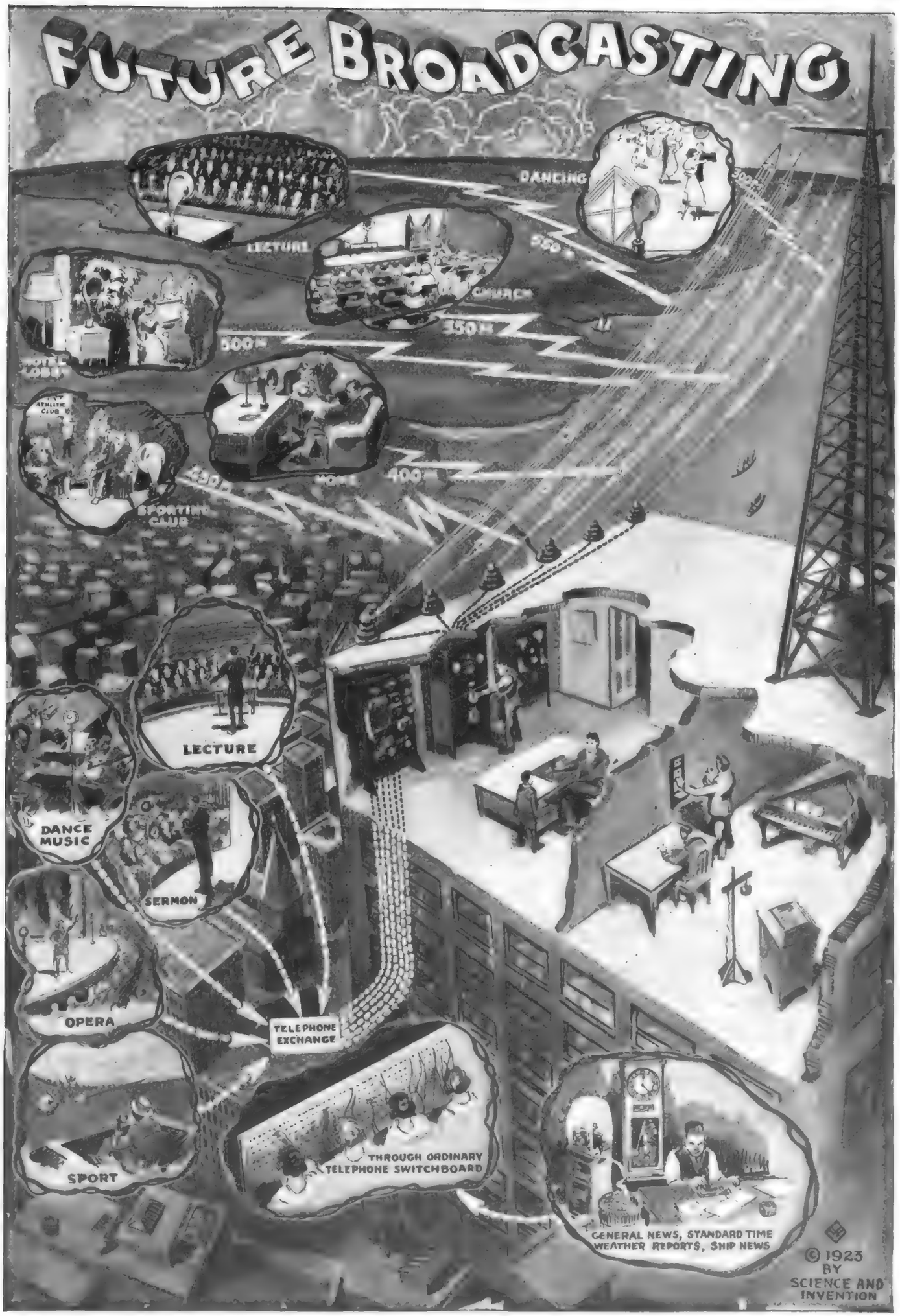

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Future Broadcasting

"FEWER broadcasting stations with better programs," that was the chief recommendation determined from a questionnaire recently circulated by the National Radio Chamber of Commerce, having offices at 165 Broadway, New York City. The replies to the questionnaires were analyzed by Ralph C. Watrous, former Lt. Governor of Rhode Island, and a member of the Chamber's special committee appointed to make a study of the broadcasting situation. Mr. Watrous said further that no exact number of stations was generally recommended, and this could not well be, as the range of stations is so rapidly changing, due both to their efficiency and to the steadily increasing range of more efficient receiving sets. The economic aspect of the broadcasting situation, as concerns the company or individual operating the broadcasting station, boils down to the fact that the more people who can be served by a single station, the less, of course, will be the expense per listener.

At present, the most serious problem to be solved, and it is hopeful that it will be straightened out very shortly by the experts connected with the Government departments at Washington, lies in the re-apportionment of wave-lengths for a group of broadcasting stations, lying within a given zone of, say two hundred miles radius or more. People who are enjoying the radiophone concerts or attempting to are in many cases disappointed by the fact that the simpler and cheaper sets are barely capable of tuning out the unwanted stations, and in some instances this cannot be done with complete satisfaction at all. Even with more elaborate vacuum tube sets, it is frequently difficult to separate one radio concert from another. There is also another trouble which ensues from the reception of half a dozen broadcast stations operating on nearly the same wave-length, such as 360 to 400 meters, all coming in at the same time, and that is, beats are produced, with a monotonous swinging note, which many people blame their receiving sets for, but which may be traced to the fact that too many powerful incoming waves are affecting the receiving set simultaneously. This is known technically as the heterodyne effect.

For instance, in the writer's case, one of the Chicago stations can be heard every night by careful tuning, and that station comes in on exactly the same wave-length as one of the powerful New York broadcasting stations, and interferes to the point that some very fine tuning has to be done in order to prevent "breaking up" the New York concert. A number of the writer's friends have complained of this interference which, as just mentioned, can be tuned out, but this sort of thing should be made impossible by reapportioning the wave-length values for such powerful station having a range of one thousand miles and the like.

As the accompanying illustration shows, we may expect, according to the ideas gained by interviews with leading broadcasting engineers, that tomorrow there will be, as already suggested by Mr. Watrous, fewer and better broadcasting stations. And that is not all, but each station will supply a diversified list of entertainments, as the picture clearly shows, giving the listeners anything they may desire from jazz to grand opera, all at the turn of a condenser dial, which may be calibrated, not in wave-lengths, but with the names of each class of entertainment, such as dance music, opera, plays, lectures, etc.

In talking over this matter with one of the American Telephone and Telegraph Company engineers connected with the broadcasting from station WEAF, he said he believes that the present method now being developed more and more every day of relaying lectures, music, etc., over telephone circuits to the broadcasting stations will survive as this is much better than going to the trouble of having all the different entertainments in separate studios in the same building. "On the morrow then," said this engineer, "we may hope to see a number of antennae atop the roof of the broadcast station building, each antenna or aerial radiating a different wave-length. Each aerial system will be connected down in the operating room with its respective vacuum tube transmitter adjusted for its particular wave-length, and to this transmitting apparatus will be connected the telephone circuit connecting with the outlying church, lecture hall, theater or other point at which the music or speech is being given for an audience or otherwise."

This method of linking the telephone system with the radio broadcasting apparatus marks a great stride forward, for there are many instances where it would be practically impossible to obtain the services of famous preachers, lecturers, or singers, otherwise than when they are talking or singing at their regular theater or church. One of the finest bits of broadcasting in some time was that which recently took place when the Metropolitan Life Insurance Company gave its annual dinner, and we could listen at home to such famous men as Charles M. Schwab, Governor Alfred Smith of New York, and other prominent speakers.

Many readers no doubt wonder how the broadcasting stations, especially when there are about eight hundred or more now operating daily, can keep "doing business at the old stand" without obtaining any revenue from those who "listen in." Even if the listeners paid but a small fee per week or month, just imagine how much revenue this would amount to when one stops to consider that stations like WEAF or WJZ of New York, or KYW of Chicago, may be providing entertainment for as many as 500,000 listeners. At the present time this question is answered by the fact that most of the broadcasting stations are being operated by newspapers, or else by concerns that in some way or other manage to make it pay. This broadcasting game has brought out some of the cleverest business geniuses that the country has ever seen, and as one of the broadcasting officials operating the WEAF station in New York recently told the writer, they practically can defy almost anyone to tell when they are listening to propaganda radiophone concerts, such as those backed by the political or other parties, and when they are not. Of course, the manager of the broadcasting station has to use his best judgment in sandwiching the bonafide entertainment numbers in between those which are paid for by political or other organizations. So from this, one may see how there are a number of channels from which the independent broadcast station can obtain revenue.

As regards future broadcasting in general, there are several schemes for making the waves secret so far as the ordinary simple receiving set is concerned, and which are at present being developed by radio engineers. One of the secret radiophone receiving and transmitting systems has been tried out by the engineers of the American Telephone and Telegraph Company, in connection with tests about a year ago with a vessel at sea, and all that one ever hears when speech is being transmitted is a broken-up mumbling sound. This represents one way in which the broadcasting station of tomorrow, if need be, can license and control listeners, and it may develop that tomorrow we shall buy receiving sets of different sizes, of course, but all of them licensed by a radio broadcasting organization or society of which the different broadcasting stations will be members, these receiving sets being provided with the necessary secret tuning apparatus.

In this way each broadcasting station could control the number of people listening to its concerts and obtain revenue either by supplying a secret "listening in" tuner or other necessary device for that particular station, or else obtain its quota of the total revenue realized by a broadcasting syndicate to which all the different stations throughout the country would belong. Without going to the trouble of splitting up the broadcasting waves in such a fashion as to render them ineffective on an ordinary receiving set not fitted with the proper interpretative device supplied by the broadcasting station service, as just described, it would of course be possible to fairly well control such matters by invoking the aid of the law; that is, to have a law passed making it a misdemeanor to possess a radio receiving set without being licensed by the broadcasting service syndicate or station, as the case may be. Whether this scheme would prove any more effectvie than the present prohibition enforcement statute, we do not know. The "radio bootlegger" would then be in order.

Radio for Miners

Preliminary experiments in the feasibility of wireless communication underground recently conducted by the Bureau of Mines in conjunction with the Westinghouse Electric Company at Bruceton, Pa., has led to the belief that a practical method may be evolved.

"While unsuccessful in indicating any practical method of using wireless waves for underground communications," said the report, "the experiments clearly indicate that waves can be sent through strata. The 'absorption' or loss of intensity with distance is very great for the short wave lengths used in these experiments. Longer wave lengths are known to suffer less absorption and may posibly be found practically effective under certain conditions."

"It was found," said the report, "that with a receiving instrument set at a point 100 feet under ground, signals from the Westinghouse station at East Pittsburgh could be heard distinctly. The Westinghouse station is about eighteen miles from the experimental mine.

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Cheap Versus Standard Apparatus

By BERT T. FERENCZ

TAKE a stroll through the streets of lower Manhattan where the "gyp" dealers in radio equipment flourish by plying their profitable trade. Note the cut-throat prices, not so obvious on standard apparatus, but on palpable imitations. Can one wonder that the layman is beguiled by actual prices such as these taken from a show-case on West Broadway, viz: variometers, 75c; variocouplers, 59c; grid condensers, 9c; variable condensers, 95c; phones, $3.19; sockets, 19c; jacks, 19c; radio frequency transformers, $1.50. When such alluring prices are labeled on these articles, how otherwise can a novice think than to forthwith buy this material, giving preference to it over standard apparatus which costs much more. Our question is, does this equipment perform as well as better made and properly designed apparatus? The answer is an emphatic *NO*.

Let us compare such apparatus with approved material, laying stress on design, efficiency, and performance. Actual figures will be quoted to show conclusively that standard apparatus is much to be preferred. The instruments used in a standard loose coupled tuning circuit with a tuned plate regenerative system is the basis for this investigation. Such a circuit includes the equipment that is used in most circuits and on that account will furnish the necessary data for our investigation.

In the antenna tuning circuit, we find a variable condenser and the primary of a variocoupler. Our only objection in the case of variocouplers, aside from mechanical imperfections, is the use of fine wire for the windings. It frequently happens also, that the leads to the secondary are brought out via the bearings of the rotor. This method, while cheap and easy causes much trouble later on, which trouble manifests itself in grinding noises due to poor contact at the varnished surfaces of the bearings. Pigtail connections are the best because an unvarying positive electrical current is afforded by their use. On the other hand, the variable condenser immediately attracts attention because of the many losses possible in it. In a well-made condenser, actual bridge measurements gave the following: Rated value by manufacturer (maximum) 0.001 mfd., measured 0.0010434 mfd. (minimum) 0.00003516 mfd. Equivalent dielectric resistance was, at maximum and minimum settings, zero ohms and 19 ohms respectively. Corresponding to these readings, the phase angle difference was negligible in the first case and approximately 11 minutes in the second case. This condenser can be called practically perfect for amateur use and is even suitable for laboratory work.

Upon measuring another condenser, with composition end plates, the following readings were observed: Capacitance 0.00049386 mfd. maximum, .00001743 mfd. minimum. Equivalent dielectric resistance losses, 847 ohms and 222 ohms for maximum and minimum settings respectively. In the first case, the phase angle difference exceeds 5°, the maximum allowable for even a poor condenser, while in the second case it measured approximately 3° 42'. When the insulation resistance was measured a reading of 58 megohms was observed. With fibre end plates the losses are not quite as high, but still high enough to render such an instrument useless in radio circuits. Considerable losses may occur at the friction contact to the movable plates, which design is followed by practically all manufacturers. Dirt, grit and grease are so apt to collect here, especially if the instrument is not enclosed, that noises and scratching sounds arise in the receivers. Here also, pigtail connections are best. The effect of high losses is a tendency to broaden the resonance band; in addition, the high resistance offered to the oscillations in the circuit, causes an appreciable decrease in the received current.

Fixed condensers are worse yet as regards losses. Most of the cheap condensers, such as those which sell for 9c to 15c, have either paper or empire cloth insulation. The tinfoil used as the conducting surface is not even glued to the dielectric material but is merely spread over the surface. When the unit is rolled up into its familiar shape, the manufacturer depends on the elasticity of the paper or empire cloth to keep the tinfoil in intimate contact with the dielectric. Of course, the result is a condenser with loose plates which, when under high potentials, will commence to vibrate. One of these paper condensers, used as a by-pass unit across an audio frequency transformer, contained such loose plates that the speech being received over the antenna could actually be distinguished, being caused by the vibration of the imperfectly adhering conducting surfaces. It was a talking condenser.

In the case of all of these paper and empire cloth insulated condensers, the losses were so high that a balance on the (General Radio Co.) *capacity bridge* could not be obtained. The equivalent dielectric resistance losses exceeded 11,110 ohms in most cases, the limit of the resistance box on the (Standard improved "Megger") bridge. Others ranged from 6,000 ohms up. If a condenser embodying such construction is used as a grid condenser, it is no wonder that poor reception is obtained.

Some of these so-called grid condensers are labelled "grid leak and condenser, ½ megohm". Actual measurements show only a slight trace of a grid leak and examination of the construction shows that the device intended for a leak is a single pencil mark half eradicated during the process of

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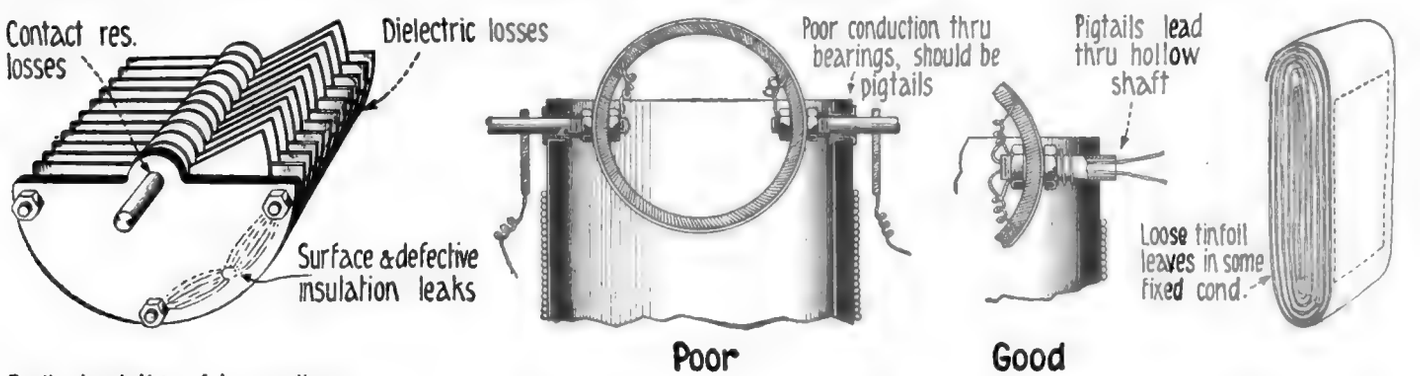
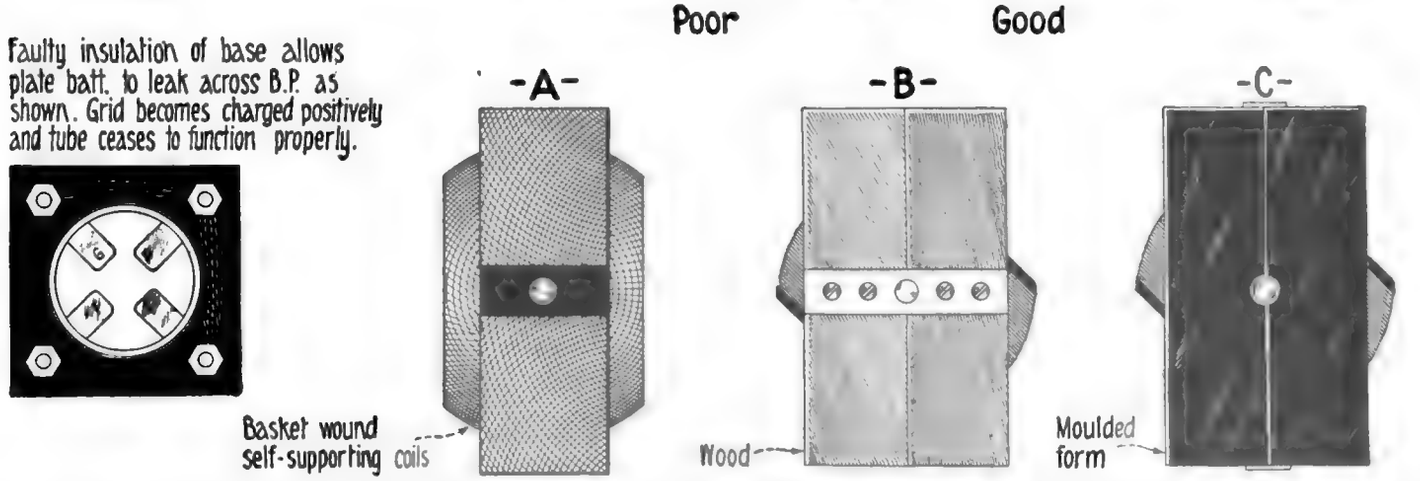

Contact res. losses
Dielectric losses
Surface & defective insulation leaks
Poor conduction thru bearings, should be 4 pigtails
Pigtails lead thru hollow shaft
Loose tinfoil leaves in some fixed cond.
Poor
Good


Faulty insulation of base allows plate batt. to leak across B.P. as shown. Grid becomes charged positively and tube ceases to function properly.
-A-
-B-
-C-
Basket wound self-supporting coils
Wood
Moulded form

We Have in General Among the Radio Fraternity Two Classes of People—Those Who Buy by Force of Circumstances or for Other Reasons, the Cheapest Apparatus to be Found on the Market, While the Second Class Endeavors to Buy Instruments Having a More or Less Good Reputation. This Article Should be Read by Every Radio Enthusiast, Especially in View of the Fact That So Many Cheap Instruments Are Now Being Placed on Sale; by Following the Advice Here Given, it Will be Possible to Improve Some of the Cheaper Instruments by Soldering Leads on Moving Coils, et cetera, as the Coils on a Cheap Vario-Coupler for Example, Will Perform Almost, if Not Quite as Well, as Those More Carefully Wound on Bakelite Tubes Found in the More Expensive Instruments. Cheap Socket Parts Can Be Remounted on Bakelite and Make a Good Job, and Bakelite Can be Substituted for Fibre on Variable Condensers with a Little Care, So as to Improve Their Efficiency.

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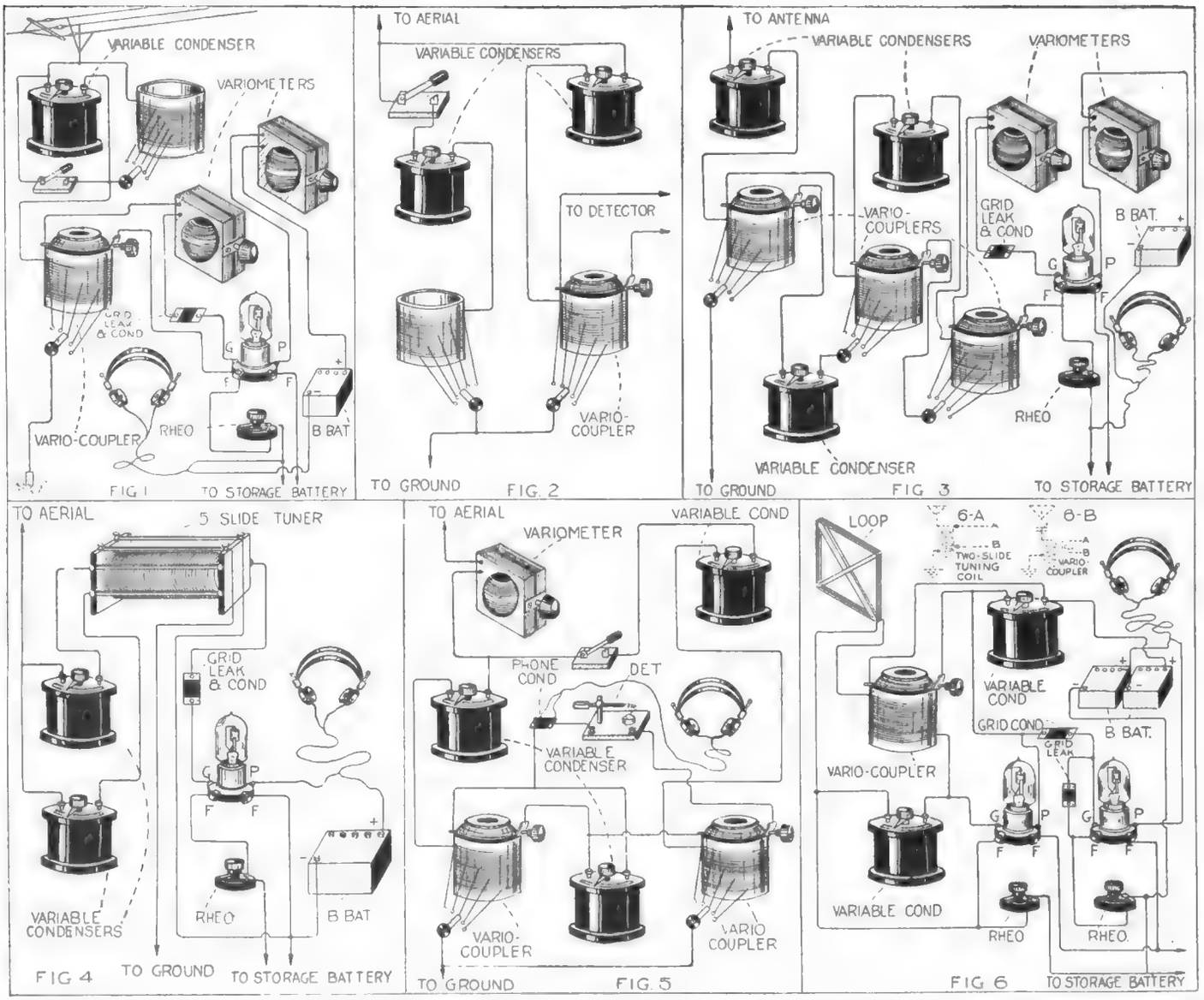

In Fig. 1 is Shown a Standard Form of Wave Trap Employing the Trap in Series with the Tuner. Fig. 2 Shows the Same Type of Trap in Parallel with the Tuner. A Filter Circuit Employing Three Vario-Couplers and Auxiliary Apparatus is Shown in Fig. 3. The Circuit Given in Fig. 4 Will Give Very Sharp Tuning and Maximum Volume by Reason of the Auto-Transformer Action of the Five-Slide Tuner. A Balanced Circuit is Shown in Fig. 5, and the Data on the Same is Given in the Text. One Stage of Radio Frequency Amplification and a Detector Used in Connection with a Special Vario-coupler and a Loop Antenna, and Connected as Shown in Fig. 6, Will Give Exceptional Results inTuning. If it is Desired to Use an Outdoor Antenna Either Circuit 6-A or 6-B Can Be Used in Connection with Fig. 6.

Wave-Traps and Interference Preventers

By A. P. Peck

THE bug-bear of the average broadcast receiving "Fan" is interference, or, in the language of the radio operator, "QRM." Standard short wave tuners consisting of a vario-coupler and two variometers, will generally eliminate interference, if in use quite a distance from the nearest broadcasting station. However, they are seldom entirely satisfactory for use in large cities where broadcasting stations are within two or three miles of the receiving station. Even with the more distant receiving stations, trouble is experienced. However, every amateur will find something in the following descriptions and the accompanying illustrations which will undoubtedly help him in eliminating interference both from broadcasting stations of approximately the same wave lengths, as well as from spark transmitters.

Probably the best known types of wave traps are those illustrated in Fig. 1 and Fig. 2. In both of these cases it has been found that the very best results may be obtained when the inductance coil has as low a resistance as possible, and the condenser as low a capacity as can be used. The writer deems it advisable to construct the coil used in these two circuits with taps for coarse adjustments, while the condenser is used for fine tuning. The best wire for winding these coils is Litz, but, if it is impossible to obtain this, No. 18 bell wire may be used with very good results. Many amateurs using these circuits, employ the ordinary honeycomb coils for the inductance, but it has been found that they are not as good as coils wound with the above mentioned wire. The inductance should have approximately the following dimensions. The form may be a cardboard or bakelite tube 3½ inches in diameter, and on it should be wound 50 turns of either Litz or other comparatively heavy wire, tapped at the 30th, 35th, 40th, 45th and 50th turns. The condenser should preferably be of the straight line type for very best results, and may be shunted with a vernier to afford close adjustment. However, very accurate adjustment of this condenser may be made, without a vernier, by attaching a long wooden or other insulating rod to the knob, at right angles to the shaft. By turning the condenser with the further end of the rod, the capacity may be very carefully and accurately adjusted.

The tuning of Fig. 1 is accomplished somewhat as follows: The switch should be closed, short circuiting the wave-trap and the set tuned as usual to the desired signal. When interference is encountered, the switch is opened, and the wave-trap circuit balanced to eliminate the interfering signal. It will generally be found necessary to retune the receiving set slightly for best results. The theory is that the oscillating circuit formed by the variable condenser and inductance will pass the frequencies to which the circuit is tuned, but will present a circuit of infinite impedance to frequencies to which it is not tuned, thereby literally choking them out. Fig. 1 shows this wave-trap in connection with a standard short wave regenerative tuner consisting of a vario-coupler and two variometers, but of course it may be used with any type of receiving set, merely by connecting it in series with the antenna.

In Fig. 2, the same coil and condenser are

(*Continued on page* 1238)

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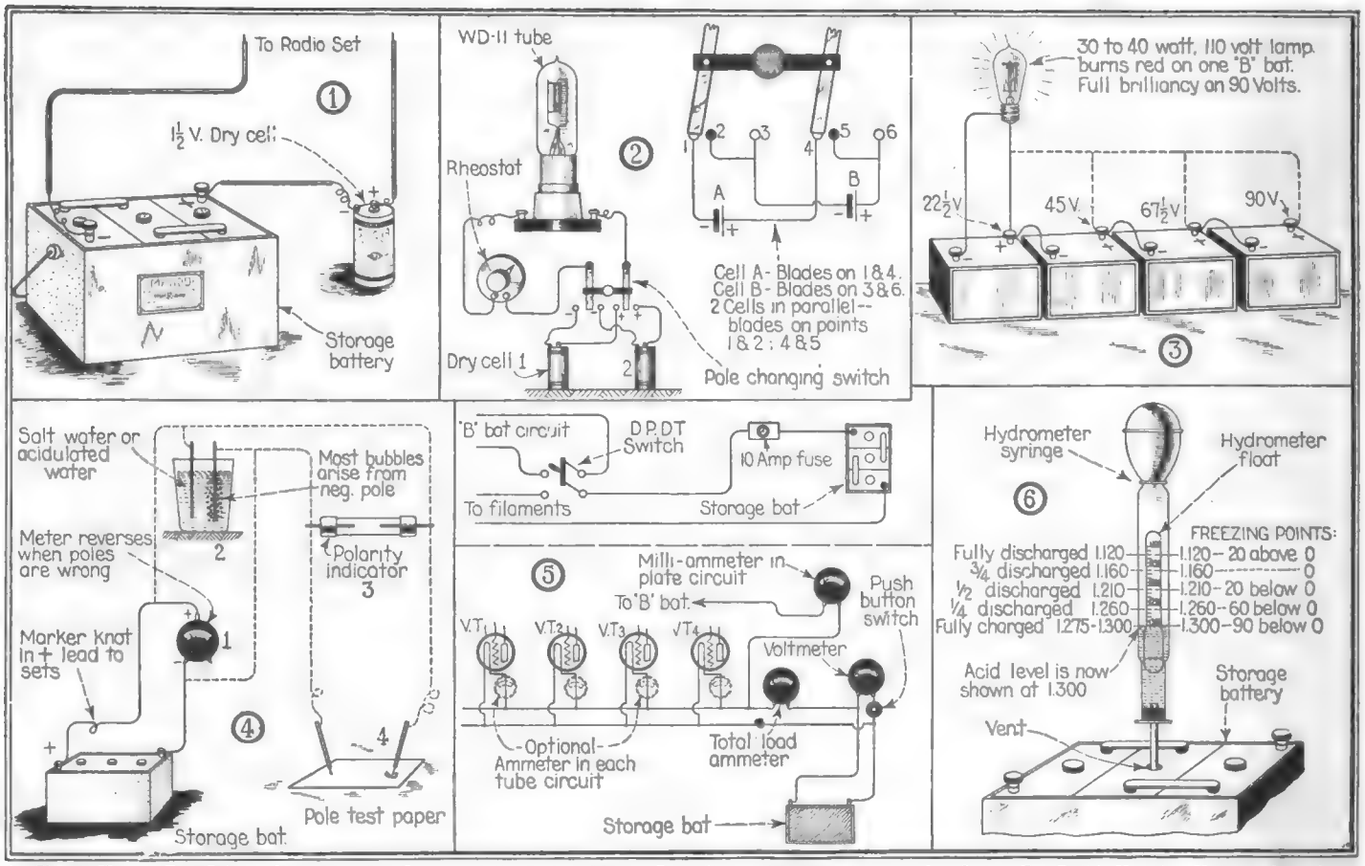

1—Shows How a Dry-Cell or Two May Be Connected In Series With a Ru n-Down Storage Battery, In Order To Build Up the Voltage For Short Emergency Periods. 2—Shows How To Connect a Pole-Changing Switch or Else Two D. P. S. T. Switches, So As To Use First One Dry-Cell and Then the Other For Alternate Periods To Equalize the Load On the Cells. 3—Shows Good Rapid Lamp Test For "B" Batteries. 4—Shows Several Methods of Determining Polarity of Storage or "B" Batteries When In Doubt. 5—Shows Protective Fuse In Storage Battery Circuit, Also Use of Volt and Ammeters In Vacuum Tube Circuits. 6—Shows How to Read Storage Battery Hydrometer As Given By Dyke.

Radio for the Beginner

By ARMSTRONG PERRY

No. 14 Batteries

THE selection of batteries for a radio receiver is a simpler matter than the multiplicity of terms and advertisements would lead the beginner to believe. There are two general types, called storage batteries and dry batteries. Neither of these common terms is correct, for the storage battery does not store electricity and the dry battery is not dry, but the storage battery does deliver electric energy in approximate proportion to that which is forced through it by the generator used in charging it, and the dry battery is not moist enough to leak on the parlor carpet.

Each type of battery is composed of units called cells. The electrical pressure, or voltage, produced by a single cell, wet or dry, of the types used with radio receivers, is from 1½ to 2 volts. The storage battery is used ordinarily where the flow of current needed is at the rate of one-half ampere or more, but where the pressure, or voltage, needed is not so great as to require many cells. Dry cells, on the other hand, are generally used when a relatively high voltage is needed, and therefore many cells, but where the required rate of flow is comparativly small.

Most of the electron tubes used a year ago in radio receivers as detectors or amplifiers required a 6-volt battery to light the filament and a 22½-volt battery to place pressure upon the plate. The heating of the metal in the filament does not require a high voltage current, but for the older types of vacuum tubes it was necessary to have a rate of flow that would quickly exhaust a dry battery. Beginners may try sooner or later to use dry cells to light the filament of a tube that requires a storage battery and find it is like trying to roast a chicken with a small can of some solidified alcohol preparation. There is heat enough while it lasts, but the fire goes out long before the job is done. Sometimes they make the mistake of connecting the 22½-volt dry battery to the filament. This has about the same effect as filling a toy balloon from an air hose used for inflating auto tires. The pressure is too high and something has to burst. The filament burns out, the tube is ruined, and the experimenter is five dollars or more out of pocket. The modern tubes which operate with a single dry cell as the A battery have changed all this.

Radio batteries are frequently referred to as "A" batteries and "B" batteries. An "A" battery is usually a storage battery and is used for lighting the filament of an electron tube. A "B" battery is usually a dry battery and is used for placing a potential or pressure upon the plate. The use of these terms came probably from the custom of draftsmen who use letters or numbers to distinguish similar pieces of apparatus shown by the same conventional sign in different positions in the same plan. In drawing a diagram of a radio receiver the custom is to start at the left with the antenna, primary and ground circuits and proceed toward the right. The conventional symbol for the electron tube shows, from left to right, first the filament, then the grid, then the plate. Therefore, the draftsman puts in the battery that lights the filament before any other and marks it "A" battery. Later he comes to the battery connected with the plate and marks it "B" battery. In highly developed receivers there may be "C" batteries also and possibly others.

The storage battery used to light electron tube filaments has been an inconvenient and troublesome factor in radio, though its steady and reliable delivery of current, when it is well cared for, makes it a necessity in the operation of tubes requiring six volts and ½-ampere or more on the filament. The battery often weighs as much as forty pounds and is therefore hard to carry. The solution used ordinarily contains a large percentage of sulphuric acid, which eats hands, clothing, woodwork, carpets, or almost anything it comes into contact with. Even the gas given off by the battery may affect surrounding objects.

These batteries are rated at 40, 60, 80 or more ampere-hours, which leads the beginner to believe that a fully charged 40-ampere-hour battery should operate a tube requiring ½-ampere on the filament for eighty hours. In practice, however, he may find that he has to have his "A" battery charged after fifty or sixty hours of use, or even less. Every time he has it charged it has to go to a charging station unless he buys charging apparatus to use in connection with his house lighting circuit. This costs nearly or quite as much as the battery, but reduces the other cost of charging to a nickel or a dime per charge.

The radio beginner who considers all these things from the start and interests himself in studying his battery and giving it the

(*Continued on page* 1202)

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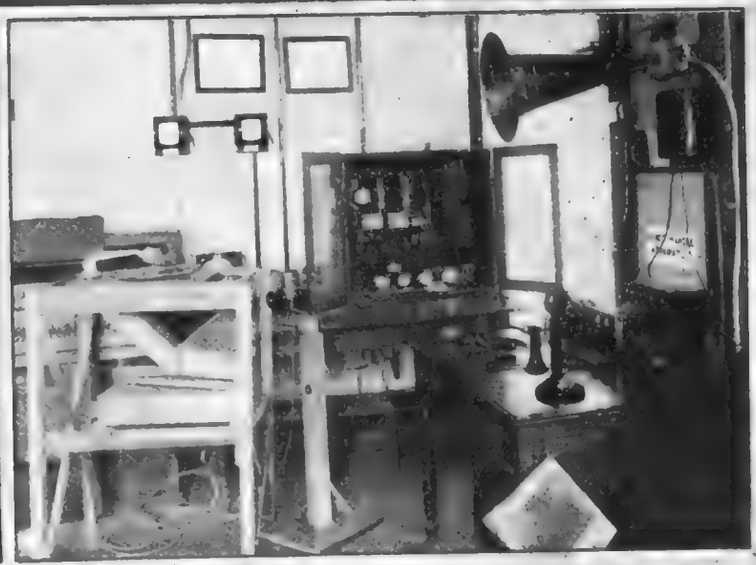
BROADCAST STATIONS

Two Top Photos: Station WHAY. The Huntington Press, Huntington, Ind. John R. Ward, operator. Left photo shows power amplifier, two phonographs and piano. The right-hand photo shows Operator Ward, and transmitting Vacuum Tube equipment.

Lower Photo: The Portland, Ore., Morning "Oregonian" radiophone station, in clock tower of building, 11th floor. Call letters KGW, 360 meters. Photo shows apparatus in glass door cabinet with improvised loud-talker horn in foreground, also specially built phonograph.



Center Photo: Broadcasting station KQY, owned and operated by Stubbe Electric Company, 75 Sixth Street, Portland, Ore. Time 1:00 to 2:00 P. M., and 6:00 to 7:00 P. M. daily, Pacific time. Range, consistent 200 miles, maximum 500 miles. A 100-watt station using 2 50-watt modulator tubes, 2 50-watt oscillator tubes, 1,000-volt 400-watt generator, radiation 5 amperes. Photo shows orchestra and transmitting apparatus in center.

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RADIO BROADCAST

IN our March, 1923, issue of this publication, we printed a complete list of broadcasting stations in these United States and Possessions. The additions, changes and corrections, should be made on the list published in the said March number. Any information regarding new stations or those not listed, will be gratuitously received by the editors, who will likewise be glad to give information regarding broadcasting stations, you may have heard either by mail or phone. Enclose stamped and self-addressed envelope when requesting such information. Address all communications to Editor, Radio Broadcast, care of SCIENCE AND INVENTION MAGAZINE, New York City.

Photos are always welcome.

ADDITIONAL BROADCASTING STATIONS NOT PREVIOUSLY LISTED

Call Letter	Name	City and State	Wave Length
KFCP	Ralph W. Flygare	Ogden, Utah	360
KFCV	Fred Mahaffey, Jr.	Houston, Texas	360
KFEL	Winner Radio Corp.	Denver, Colo.	360
KFFB	Jenkins Furniture Co.	Boise, Idaho	360
KFFQ	Marksheffel Motor Co.	Colorado Springs, Colo.	360
KFGB	Lowenthal Bros.	Pueblo, Colo.	360
WMC	Commercial Appeal	Memphis, Tenn.	400-485
WPAY	Bangor Radio Laboratory	Bangor, Me.	360
WPAZ	Dr. John R. Koch	Charleston, W. Va.	360
WQAD	Whitall Electric Co.	Waterbury, Conn.	360
WQAF	Sandusky Register	Sandusky, Ohio	360
WQAH	Brock-Anerson Electrical Eng. Co.	Lexington, Ky.	360
WQAJ	Ann Arbor Times News	Ann Arbor, Mich.	360
WQAM	Electrical Equipment Co.	Miami, Fla.	360
WQAN	Scranton Times	Scranton, Pa.	360
WQAO	Calvary Baptist Church	New Ydrk, N. Y.	360
WQAR	Press Publishing Co.	Muncie, Ind.	360
WRAC	State Normal School	Mayville, N. Dak.	360
WRAD	Taylor Radio Shop	Marion, Kans.	360
WRAJ	M. H. Pickering Co.	Pittsburgh, Pa.	360
WRAM	Lombard College	Galesburg, Ill.	360
WRAO	Radio Service Co.	St. Louis, Mo.	360
WRAV	Antioch College	Yellow Springs, Ohio	360
WSAA	B. S. Sprague Electrical Co.	Marietta, Ohio	360
WSAB	Southeast Missouri State Teachers' College	Cape Girardeau, Mo.	360

CORRECTIONS AND CHANGES IN OUR REVISED AND CORRECTED LIST APPEARING IN THE MARCH ISSUE OF THIS MAGAZINE, SAID ISSUE CONTAINING CALL LETTERS, NAMES AND LOCATIONS OF ALL BROADCASTING STATIONS IN THE UNITED STATES AND POSSESSIONS.

KFAW (Santa Ana, Calif.) should read, Station operated and controlled by Radio Den.
KFDF (Casper, Wyo.) add 485 to 360 wave-length.
KFI (Los Angeles, Calif.) change wave-length to 400.
KLN (Del Monte, Calif.) change to Monterey, Calif.
KPO (San Francisco, Calif.) change wave-length to 400.
WCAU (Philadelphia, Pa.) should read, station operated and controlled by Durham & Co.
WCK (St. Louis, Mo.) should read, station operated and controlled by Stix-Baer & Fuller Dry Goods Co.
WDT (New York, N. Y.) change to Stapleton, N. Y.
WEAU (Sioux City, Iowa) add 485 to 360 wave-length.
WHAM (Rochester, N. Y.) should read, station operated and controlled by University of Rochester (Eastman School of Music).
WMAQ (Chicago, Ill.) should read, The Fair and Chicago Daily News.
WPE (Kansas City, Mo.) change to Independence, Mo.
WPG (New Lebanon, Ohio) add 485 to 360 wave-length.

Strike out following stations on last month's list: **KDYO**, Carlson and Simpson, San Diego, Calif.; **KDZP**, Newbery Electric Corp., Los Angeles, Calif.; **KDZW**, Claude W. Gerdes, San Francisco, Calif.; **KFAC**, Glendale Daily Press, Glendale, Calif.; **KFBM**, Cook & Foster & Astoria Hardware Co., Astoria, Ore.; **KFBN**, Borch Radio Corp., Portable, Calif.; **KFBQ**, Savage Electric Co., Prescott, Ariz.; **KFC**, Northern Radio & Electric Co., Seattle, Wash.; **KJC**, Standard Radio Co., Los Angeles, Calif.; **KVQ**, Sacramento Bee, Sacramento, Calif.; **KYY**, The Radio Telephone Shop, San Francisco, Calif.; **KZY**, Atlantic and Pacific Radio Supply Co., San Francisco, Calif.; **WAAX**, Radio Service Corp., Crafton, Pa.; **WBAB**, Andrew J. Potter, Syracuse, N. Y.; **WBAJ**, The Marshall Gerken Co., Toledo, Ohio; **WDAQ**, Hartman Riker Electric & Machine Co., Brownsville, Pa.; **WDAV**, Muskogee Daily Phoenix, Muskogee, Okla.; **WGAS**, The Ra-di-co Organization, Chicago, Ill.; **WHW**, Stewart W. Seeley, East Lansing, Mich.; **WJAC**, Redell Co., Joplin, Mo.; **WJAL**, Victor Radio Corp., Portland, Me.; **WJAU**, Yankton College, Yankton, S. Dak.; **WKAZ**, Landau's Music & Jewelry Co., Wilkes-Barre, Pa.; **WLAO**, Anthracite Radio Shop, Scranton, Pa.; **WNAG**, Rathert Radio & Electric Shop, Cresco, Iowa; **WNAH**, Wilkes-Barre Radio Repair Shop, Wilkes-Barre, Pa.; **WNAJ**, Benson Co., Chicago, Ill.; **WPAG**, Central Radio Co., Independence, Ill.; **WPJ**, St. Joseph's College, Philadelphia, Pa.; **WSN**, Ship Owner's Radio Service, Norfolk, Va.; **WSX**, Erie Radio Co., Erie, Pa.

ELABORATED LIST GIVING TIME AND NATURE OF BROADCASTS. (Continued from previous issues.)

WOQ—Western Radio Company, Kansas City, Mo.—360–485
Weather, lectures, market reports, vocal and instrumental talent, sermons, news bulletins and special features Mondays, Tuesdays, Wednesdays and Thursdays 9.45 A. M., 10.55 A. M., 11.30 A. M., 12.30 P. M., 2.00 P. M. and 7.15 P. M. Fridays and Saturdays 9.45 A. M., 10.55 A. M., 11.30 A. M. and 12.30 P. M. Fridays 1.15 P. M., 2.00 P. M., 7.15 P. M. Saturdays 7.15 P. M. and 8.00 P. M. Sundays 7.00 P. M. Consistent range 1,000 miles, maximum coast to coast.

WOS—Missouri State Marketing Bureau, Jefferson City, Mo.—360-485
Weather, lectures, market reports, vocal and instrumental talent, baseball scores, news bulletins and special features daily except Sundays, 9.30 A. M., 11.00 A. M., 2.00 P. M. and 5.00 P. M. Mondays, Wednesdays and Fridays 8.00 P. M. Central standard time.

WPG—Nushawg Poultry Farm, New Lebanon, Ohio.—360-485
Lectures, vocal and instrumental talent, sermons, news bulletins and special features daily 1.00-3:00 P. M. Mondays, Wednesdays and Fridays 7.30-9.45 P. M. Consistent range 750 miles, maximum 1,560.

WPO—United Equipment Co., Memphis, Tenn.—360
Lectures, music, vocal and instrumental talent, sermons, baseball scores, news bulletins and special features daily 7.15-8.15 P. M. Consistent range 300 miles, maximum 400.

WRK—Doron Bros. Electric Co., Hamilton, Ohio—360
Lectures, music, vocal and instrumental talent, sermons, baseball scores, news bulletins and special features daily except Sundays, 12.00-1.00 P. M. and 7.00-11.00 P. M. Sundays 10.45 A. M. and 12.00 noon. Consistent range 500 miles, maximum 2,200.

WSB—Atlanta Journal, Atlanta, Ga.—400-485
Weather, lectures, market reports, vocal and instrumental talent, sermons, baseball scores, news bulletins and special features daily except Sundays, 12.00-1.00 P. M., 2.30 P. M., 4.00 P. M., 5.00-6.00 P. M., 7.00-8.00 P. M., 10.45-11.45 P. M. Sundays 11.00 A. M., 5.00 P. M. and 8.00 P. M. Consistent range 1,500 miles, maximum 2,300.

WSY—Alabama Power Co., Birmingham, Ala.—360-485
Time signals, lectures, market reports, vocal and instrumental talent, sermons, baseball scores, news bulletins and special features daily except Sundays, 2.30 P. M. Daily 8.00-9.00 P. M. Central time.

WWI—Ford Motor Company, Dearborn, Mich.—360
Lectures, music, Wednesdays 10.00-11.00 P. M. Eastern standard time. Consistent range 300 miles, maximum 1,200.

WWJ—Detroit News, Detroit, Mich.—400-485
Weather, time signals, lectures, market reports, vocal and instrumental talent, police bulletins, sermons, baseball scores and special features. Mondays, 9.30-9.40 A. M., 9.40-10.15 A. M., 10.25-10.30 A. M., 10.55-12.00 noon, 12.05-12.45 P. M., 3.00-3.30 P. M., 3.30-3.40 P. M. and 3.40-4.15 P. M. Thursdays 5.00-5.10 P. M., 5.10-5.30 P. M., 7.00-8.30 P. M. and 8.30-10.00 P. M. Sundays 9.00 A. M. to 2.30 P. M., 11.00-12.30 P. M., 4.00-6.00 P. M. Time split up as indicated because of different types of features on daily program. Consistent range 1,000 miles, maximum 2,500.

(To be continued in the next issue—Save these as they will not be repeated.)

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Radio Oracle

In this Department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this Department cannot be answered free. A charge of 25c is made for all questions where a personal answer is desired.

LONG WAVE TUNER WITH CRYSTAL DETECTOR

(127) Frank Bandond, New York City, asks:

Q. 1. Can the so-called all-wave coupler be used to make a long distance crystal receiving set without the use of audion tubes?

A. 1. An all-wave coupler cannot be used efficiently with a crystal detector. These couplers are designed for use with an audion detector, whereupon the rotor is used as a tickler. No matter what apparatus you use with a crystal detector, radiophone broadcasts can very seldomly be received over a distance of more than 30 miles. Under ideal conditions this range becomes quite consistent but such conditions are not found everywhere.

TUNING CIRCUITS

(128) Donald Breet, Dorchester, Mass., requests:

Q. 1. Will you please publish a diagram of a short wave regenerative tuner consisting of 2 variable condensers, two variometers and a vario-coupler for use with a WD-11 tube?

A. 1. A diagram of such a short wave regenerative set appeared on page 722 of the December issue of SCIENCE & INVENTION. One of your variable condensers may be used across or in series with the primary of the vario-coupler. It will not be necessary to use the other one. A WD-11 tube can be employed in this circuit by substituting a dry cell for the storage battery, in the circuit given.

Q. 2. Please give a diagram of a set consisting of a 43-plate variable condenser, a vario-coupler, a crystal detector, a fixed condenser and a pair of phones.

A. 2. Fig. 2 on the same page shows the connection for a crystal set. A vario-coupler may be used in place of the loose-coupler in this circuit. Since your aerial is quite long we would advise the insertion of a variable condenser in series with the antenna.

Q. 3. Will a loose-coupler or a vario-coupler be best for use in the above circuits?

A. 3. It really does not make a great deal of difference whether you use a vario-coupler or a loose-coupler, but the former adapts itself very well to panel-mounting, which the latter does not. It is generally a matter of choice and taste whether you use a vario-coupler or a loose-coupler.

ROGERS UNDERGROUND AERIAL

(129) B. O. Bock, Tampico, Tamps., Mexico, writes:

Q. 1. Is the Rogers underground antenna efficient for transmission?

A. 1. The Rogers underground antenna is not particularly adapted to transmission. This antenna however, in receiving, reduces static to a very great extent, and allows reception through periods of severe atmospheric disturbances, even through thunderstorms.

Q. 2. Where can I obtain complete information on this antenna?

A. 2. A very complete treatise on this work appeared on page 786 of the December, 1919 issue of SCIENCE & INVENTION, and a very good one in the June, 1919 issue also. If you will refer to these issues you can obtain all the information thereon that you desire.

VARIOMETER WITH CRYSTAL SET

(130) Arthur Boughner, Cadillac, Mich., asks:

Q. I. Could a variometer be used to improve a crystal set which now uses a loose-coupler and variable condenser for tuning?

A. 1. A variometer could not be used to increase the range of a crystal receiving set, nor for that matter, could any other tuning device. You may, however, improve the selectivity of your set slightly by connecting the variometer in series with your aerial.

SPIDER-WEB RECEIVING SET

(131) Jos. R. Cook, Kerrville, Texas, refers to the receiving set which won fifth prize in our Simplest Radiophone Contest, and requests:

Q. 1. In what order should the five discs be assembled?

A. 1. The primary disc coil should be placed next to the disc upon which is mounted the switch, the secondary coil next, and the primary loading coil last In back of this is placed the fifth disc which is used as a finishing touch.

Q. 2. What kind of wire gives best results for the cat-whisker is a galena detector?

A. 2. Very fine phosphor bronze wire will generally give very good results when used as the cat-whisker, but a 14-carat gold wire will be much better, due to the fact that it does not oxidize as readily, and therefore will not form an imperfect contact as easily as bronze wire will.

LONG DISTANCE RECEPTION

(132) Jaren Drug Co., Barrett, Minn., says: I would like to construct a set which will enable me to receive radiophone messages from both the Atlantic and Pacific coasts. He asks:

Q. 1. Can you give me any help in this matter?

A. 1. A radio set which will receive from coast to coast, could of course, be home-made, but such a set requires quite an experienced operator to attain efficient results. We would not advise anyone who is not well versed in radio, to attempt the construction of such a set without making a much smaller beginning. We would advise you to start by making a short wave regenerative tuner such as described in the December, 1921 issue of SCIENCE & INVENTION. This set should be used in connection with a single detector tube, until the builder becomes thoroughly familiar with its operation. To this may then be added two stages of audio frequency amplification, in a manner such as has been frequently illustrated in various past issues of this magazine. After this combination is thoroughly mastered, two stages of radio frequency amplification should be added, as illustrated on page 156 of the June, 1922 issue of SCIENCE & INVENTION. The resulting set, will, if handled properly, receive from coast to coast and reproduce the voice on a loud-speaker, when used in connection with an outdoor aerial at least 100 feet long and as high as possible.

SINGLE CIRCUIT TUNER

(133) Harold Clothier, Galt, Ont., Canada, asks:

Q. 1. Can you give me a diagram of a vario-coupler which has two separate windings upon the stator as well as a rotor?

A. 1. We are giving herewith a circuit diagram as requested by you. This tuner is of the single circuit type with a divided winding on the stator

Features in April "Radio News"

Transmission of Photographs by Radio — By S. R. Winters

A New Radio Frequency Receiver — By Wayne R. Jamison

Electrons, Electric Waves and Wireless Telephony — By Dr. J. A. Fleming

The Construction of a Detector and Two Step Amplifier — By Arthur W. Lambert, Jr.

Mr. Brownlee's Loud Talker — By Ellis Parker Butler

Radio in England — By M. B. Sleeper

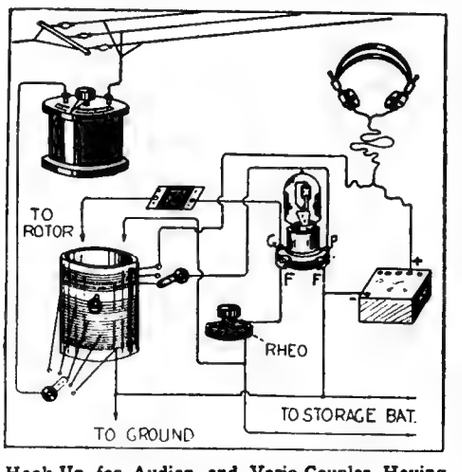
The Itch for Distance — By Armstrong Perry

Q. 2. Dill you give me the constructional data for such a transformer?

A. 2. The larger stator winding should consist of about 100 turns of No. 22 S.C.C. wire, tapped every 10 turns. The smaller stator winding should consist of about 20 turns, tapped at the center turn. These windings are connected up with the switches as indicated in the diagram. The rotor should be of the ball type, with each side wound with as many turns of No. 24 wire as it will hold. Such a tuner should tune to about 600 meters, providing the stationary coil is approximately 4 inches in diameter.

Q. 3. What is the receiving range of such a tuner used in connection with an audion detector?

A. 3. Such a set using one tube should have a consistent receiving range of about 75 miles with an outdoor antenna.



Hook-Up for Audion and Vario-Coupler Having Two Stator Windings.

CAUSES OF HOWLING

(134) Harold Counts, Chillicothe, Ohio, says: I have considerable trouble with my regenerative receiving set which takes the form of howling in the loud-speaker. I have tried various methods of eliminating this, but have obtained no success. He asks:

Q. 1. Can you suggest any remedy for this trouble?

A. 1. There are several reasons why vacuum tube sets howl. Loose connections, low grade "B" batteries, improperly adjusted "A" battery, and unbalanced circuits are among the causes. Other reasons have been listed in this department before. This trouble may also be caused by body capacity, which may be eliminated by shielding the instruments with aluminum plates. These plates should be grounded. This work was explained thoroughly on page 882 of the January, 1923, issue of SCIENCE & INVENTION. Shielding the transformers may also help. There may be something wrong with your loud-talker.

CONDENSER CALCULATION

(135) L. L. Davis, Rutherford, N. J., asks:

Q. 1. Kindly give formulas for designing fixed condensers for use in radio receiving sets.

A. 1. The formula for the calculation of the capacity of condensers, is $C = 0.0885K \frac{S}{T}$ micro-microfarads.

In this formula, S equals the surface area of one plate, T equals the thickness of the dielectric, and K equals the dielectric constant, (K equals 1.000 for air, and for most ordinary substances lies between one and ten).

If instead of a single pair of metal plates there are N similar plates with dielectric between, alternating plates being connected in parallel, use the following formula. $C = 0.0885K \frac{(N-1)S}{T}$

These formulas are fairly accurate and will give good results for ordinary use. In them no allowance is made for the curving of the lines of force at the edges of the plates, the effect being negligible when T is very small, as compared with S.

From the above formulas you can calculate all kinds of condensers using any kind of dielectric. The dielectric constants may be found in any up-to-date text book on electricity.

A. C. ON TUBES

(136) Stephen N. Hartig, Chicago, Ill., asks:

Q. 1. Why is not alternating current used more extensively for operating vacuum tubes in radio reception?

A. 1. The characteristics of alternating current do not lend themselves very well to use on audion tubes unless elaborate rectifying apparatus is used, the expense of which, with the attendant filters is too great for the amateur.

Q. 2. Can you give me any information as to where I can obtain data on this work?

A. 2. One of the few efficient circuits for this work appeared on page 469 of the September, 1922, issue of SCIENCE & INVENTION.

WAVE LENGTH VS. RECEIVING RANGE

(137) Francis T. Bearse, Chatham, Mass., asks:

Q. 1. What distance will the long wave receiving set described in the Radio Oracle in the July, 1922, issue of SCIENCE & INVENTION receive radiophone broadcasting and signals?

A. 1. The wave-length range of the radio receiving set has absolutely nothing whatsoever to do with the receiving range. They are two entirely separate and distinct measurements. The wave-length range refers to the length of the waves to which the tuner will respond, and the receiving radius refers to the distance over which the set will receive. It is practically impossible to make more than a rough guess at the receiving set of any set due to the many factors which enter into this work.

Q. 2. Would I be able to receive WGI and WBZ with this set located in my home?

A. 2. We believe that you will have no trouble in receiving the above named stations with this set, provided the same is constructed and operated correctly.

Q. 3. How can a single circuit tuner using a vario-coupler, the primary as an auto-transformer, and the secondary as the tickler, be changed so as to receive from stations operating on a wave-length of 2500 meters.

A. 3. With some types of vario-couplers it will be sufficient to insert a honeycomb coil in series with the antenna, the size of said coil to be such that it will load the circuit to the required wave-length. With other couplers it is sometimes found necessary to load the tickler circuit. This may be accomplished in the same way, that is, by connecting a honeycomb coil in series with the tickler winding. The size of this coil will have to be determined by experiment, and it will have to be changed every time the coil in series with the antenna is changed.

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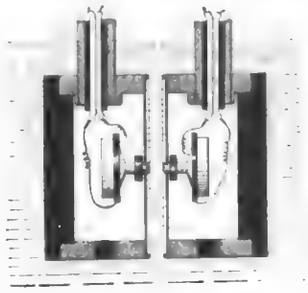
LATEST PATENTS

Submarine Signaling

(No. 1,440,360 issued to Frank L. Hopwood)

Instead of the usual method of employing but one diaphragm and microphone in a hydrophone for submarine signaling, this patent describes the use of two hydrophones, so that should one break down the

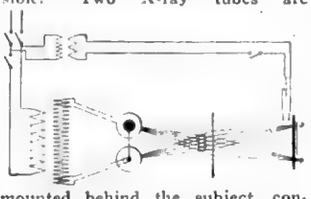


other is available for reception in the ordinary manner, while at the same time each diaphragm serves to act as an intensifier to the other. Both diaphragms are mounted so that they face each other, whereupon one being set in vibration will cause the other to vibrate as though the water between them were a connecting rod. For this reason the method suggested is thought to be more sensitive than if but one diaphragm were employed. It is claimed that sharpness of tuning and greater selectivity are possible by this method.

Stereoscopic X-Rays

(No. 1,438,500 issued to Leslie R. McDonald)

It has always been difficult to obtain stereoscopic vision of an individual X-rayed, but with this method such effects should be possible. Two X-ray tubes are



mounted behind the subject, connected up in such a manner that the pulsating direct current on which they operate would first affect one tube and then the other. Operated synchronously with this pulsating current is a vibrating shutter mounted in a head rest, and so arranged that it will cut off vision from the observer's eye. First vision is cut off from the right eye and then from the left. Simultaneously with this the spark passes between the electrodes of one X-ray tube and then the other. Consequently, X-ray vision giving objects a stereoscopic effect becomes possible. The system simulates the stereoscopic moving picture production, using the revolving shutter for producing such effects.

Tension Device for Stringed Instruments

(No. 1,441,702 issued to Bertie E. Mills)

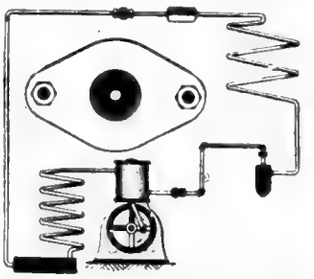
A violin supported on a bedplate is played by sounders which rotate

over the springs and by means of ... each act on the individual ... its head a peculiarly shaped lever is found, the string passing over the curved elongated bearing on the lever, which is so arranged that the bearing portion on the spring in its taut condition is rendered comparatively slight due to the curved head portion of this lever. At the same time the string may be easily tuned by simply adjusting the angle of this lever.

Refrigerating Apparatus

(No. 1,436,815 issued to Albert T. Marshall)

For those who have built the electrical refrigerator described in this publication some time ago, this patent will be of interest. In all these systems irregularities of operation will sometimes occur, which cause a certain amount of the liquid to pass through the refrigerating coils without assuming a gaseous condition. In order to prevent this, the inventor of this device provides a diaphragm having a small orifice at its center on the axis of the pipe, which is inserted into the suction line near the compressor. The area of the hole is one-tenth to one-fifteenth the area of the suction pipe. The beneficial

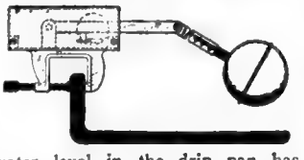


action may be ascribed to the different effects of the change in velocity of gaseous and liquid refrigerants. The major portion of the liquid is held back by the diaphragm, but portions of it are picked up by the rushing current of vapor, which portions are sprayed into the suction line to evaporate there.

Overflow Alarm

(No. 1,434,112 issued to Harry Gessler)

This is a household utility which, if manufactured at a reasonable price, would find a ready market. It consists of an adjustable float pivoted within a metallic box containing a train of gears and a clock spring. A clamp secures the box and clock spring to the side of a drip pan such as may be placed beneath an ice box. When the

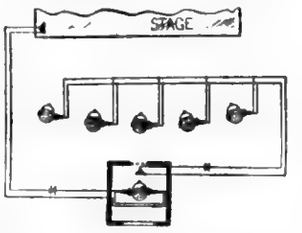


water level in the drip pan has attained the predetermined height to which the float has been adjusted, the float as it rises releases a clapper which strikes against a metallic disk telling all within hearing distance that unless the water is removed from the drip pan a mop will have to be employed to wipe up the floor. In case sister desires to have her little brother empty the water from the pan, she can set this so that the alarm will go off when the pan is but one-quarter filled.

Telephone System for Theatres

(No. 1,435,339 issued to Paul Schweyer)

It is difficult to ascertain just what advantages this system of transmitting intelligence to the theatre audiences gives. The inventor claims that the drawback in devices of this nature is that the sound as transmitted by the speaker, and picked up by microphones is conveyed to the audience quicker than that propagated through the air, consequently, the auditors lo-

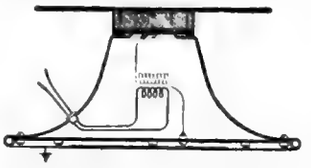


cated in the theatre at a distance from the stage, hear a confusion of musical sounds and voices, which is true. In the present system the sounds are picked up by a microphone and transmitted to an assistant located in a sound-proof room, who repeats the words and relays them in this manner to the auditors. We are of the opinion that this would result in a greater confusion than with systems already tried.

Protecting Articles from Creeping Insects

(No. 1,441, 606 issued to Franklin S. Smith)

In the southern portions of the United States great difficulty is experienced in protecting articles from insects, such as ants; candy and other food being destroyed by them. The inventor has, therefore, designed a tapered pedestal of sheet metal, which is continuous almost all the way up except for a small fibre insulating rim. Opposite sides of the pedestal on either side of this ring are connected to the terminals of a step-up transformer, and



the candy or other food is placed on top of the pedestal. When an insect crawls up the side of the structure its legs come in contact with the high tension circuit of about 4,000 volts, which either kills the insect or cripples it. It will be seen, therefore, that the food is well protected from all kinds of creeping insects.

Advertising Device

(No. 1,441,245 issued to Miles J. Ryan and George F. Jones)

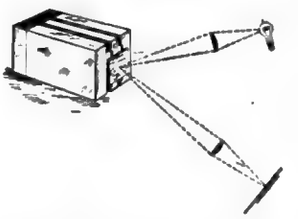
We are illustrating this patent because of its marked simplicity. Essentially it consists of an indicator in the form of an arrow or a hand mounted at the end of a rod, so that its direction can be adjusted or it may be mounted on a flexible gooseneck coupling. The lighting cable passes through the flexible gooseneck, and it terminates at the socket of an incandescent bulb located within the indicator.

The glass of the indicator is preferably colored so that the purchaser's eye will be attracted to the objects pointed out. If desired, names such as "bargain counter," "hosiery," etc., may be placed on the indicator. It is rather strange that this mechanism has not been patented heretofore.

Piezo-Electrical Voltage Indicator

(No. 1,438,974 issued to Edward C. Wente)

In apparatus heretofore available for the analysis of complex sound waves, the analysis of vowel sounds has been quite successfully accomplished. For the analysis of consonant sounds, it is essential that the apparatus have little or no distortion for frequencies up to ten thousand cycles per second. Considerable difficulty has therefore been experienced in the design of an oscillograph, which has uniform characteristics. In this invention two piezo-electric crystals are supported within a block. To the ends of the crystals a mirror is attached. The microphone and batteries are then connected into the circuit, so that one of the crystals will elongate and the other con-

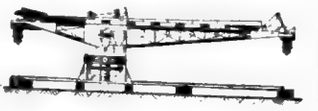


tract, causing the mirror to be rotated, and consequently the ray of light to be deflected in accordance with sound vibrations. The electrical circuits to the crystals are completed by tinfoil surrounding the same crystals.

Airplane Receiving Apparatus

(No. 1,437,236 issued to Richard Gibbons)

Instead of a catapult launching device for airplanes, the inventor of this airplane landing runway has designed a receiving apparatus differing in construction but built on almost similar lines. The airplane supporting surface is composed of a series of continuous traveling webs connected through gears and rollers to a motor, which webs are caused to rotate in the direction opposite to the movement of the airplane. Compressed air may be forced against the wings of the plane, so that it shall not leave



the runway. Beneath the traveling webs some distance from the end of the runway is a magnetic clutch which further increases the breaking action on the plane. On either side of the runway, side guides are employed to prevent the plane from rocking and to further maintain it on the webs. The guides are wide at the entrance and narrow toward the stopping place. At the distant end an inclined traveling web is also found, whose angled inclination is adjusted by means of a pneumatic cylinder, the cylinder likewise acting as a shock absorber. The entire device is so constructed that it may be rotated on a longitudinal axis, or elevated, or the angle of its inclination changed.

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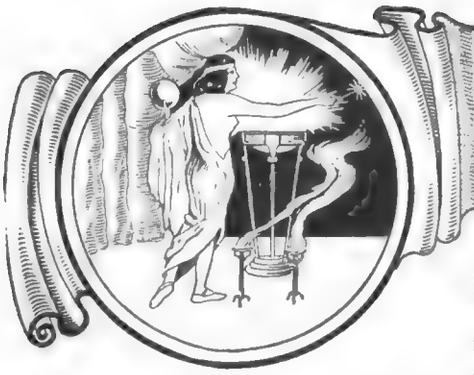

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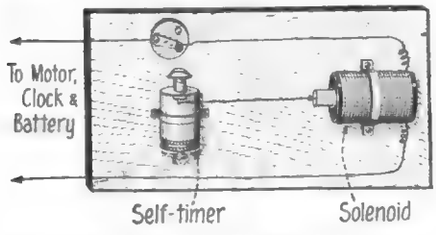
Radiator Control

(1435) B. L. Rites, Asheville, N. C., says: I have a plan to operate the radiator valve in my room so as to open it some time before I arise. I intend to use a small electrical motor to open the valve, but would like to know how to stop this motor in 10 to 15 seconds. The motor is to be started by having the hour hand of the alarm clock close a circuit. He asks:

Q. 1. Can you give me a suggestion for stopping the motor after it has run the required length of time?

A. 1. We presume from your letter that your radiator has a valve which is opened by several turns of a knob. Therefore, the best time-switch which you can use to operate in 10 to 15 seconds, is one similar to that described below. Obtain a camera self-timer from any photographic



By Means of the Device Illustrated Above, Any Electrical Apparatus May Be Made to Stop at Any Time Up to Three Minutes After it Has Started.

supply store, remove the yoke into which the cable release is designed to slip, and bend the trigger which lays parallel with the barrel, so that it will extend at right angles to the same. Drill a small hole in this trigger and fasten the self-timer to a base by means of a strap. Construct a solenoid using a brass tube ¼ inch in diameter by 1½ inches long, for a core, and wind it with about 6 layers of No. 20 D. C. C. magnet wire. An iron plunger is arranged so as to be drawn into the solenoid, and is attached to the self-timer by means of a thread as shown, after the solenoid is mounted upon the base. A little experimenting will show that when the plunger of the self-timer is pushed down and the trigger released, the plunger will travel slowly (the speed of travel being governed by the screw on the bottom of the timer), for a distance of approximately ½ inch, and then will jump suddenly to its full extent. Mount a single point battery switch in front of of the self-timer as shown, in such a position that the point of the switch will be as far from the self-timer as the plunger extends before "jumping."

The entire apparatus is now hooked up as shown. Before retiring at night, the self-timer is set at a predetermined speed. Now when the clock closes the circuit, the motor will start running, the solenoid will draw the core in, the trigger of the self-timer will be released, and the plunger will slowly travel up. Suddenly it will jump and push the lever of the battery switch from the point, thereby opening the circuit and stopping the motor.

Relation of Coal Mined to the Rotation of the Earth

(1436) Paul Mitchell, San Diego, Cal., asks:

Q. Since we discovered coal and other fuel deposits many centuries ago, and we burn millions of tons every year, does not this make a difference in the speed of rotation of our earth?

A. 1. In comparison with the bulk or mass of the earth, the amount of coal mined therefrom and burned each year, is so infinitesimally small, that it does not affect the rotation of the earth in any appreciable manner.

Weight of Bodies at Pole and Equator

(1437) R. D. Elkins, San Francisco, Cal., says: we learned in school that the earth is a sphere, slightly flattened at the poles. He asks:

Q. 1. Would not this make the poles nearer the center of the earth, and therefore cause a body to weigh more at the pol
equator?

A. 1. You are quite right
body weighs more at the poles
It has been found that the s
at the equator is 13½ miles f
ter than at the poles, whic
gravity by about 1/555. B
trifugal force, the gravity at
by about 1/289. It can eas
that the whole reduction is
In other words, an object
190 pounds at the equator w
near the pole. It must be
weights must be determined
curate spring balance, for
if an ordinary balance
used for balancing would

Varying Hei

(1438) Albert Shaw,
claims that the Pacif
Atlantic, and that th
at the Panama C
are on the same
Q. 1. What is
tion?

A. 1. There ar
in the Panama C
water is fed from
of these locks, rath
through on a lev

considerable amount of labo
locks are used. The other is
Atlantic and Pacific oceans
same times, and some tim
other if the two oceans wer
entirely free of locks. Anot
is that the Pacific is about
the Atlantic at the Panama
Q. 2. What is steam anc
of?

A. 2. Steam is the vapor
when heated. It is water i

Hand Soap

(1439) A. P. Kitchen,
quests:

Q. 1. Can you give me
grade of hand soap?

A. 1. We are giving you
recipie for a hand soap.

Cocoanut oil, 600 parts
Powdered pumice stone
Caustic soda lye, 40° B.
Lavender oil, 3 parts
Caraway oil, 1 part

The oil is heated, and the
90° Fahrenheit; next the po
is sifted into the soap, and

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Radio for the Beginner

By ARMSTRONG PERRY

(*Continued from page* 1194)

care it needs, meets no serious difficulties, but the beginner who buys a battery with the expectation that his duties end with the paying of the bill is sure to encounter disappointments. The pressure brought to bear upon the radio industry by customers who did not want to do anything but "listen in" resulted in the development of a new type of tube with a little filament that takes so small an amount of current that it can be lighted with one ordinary dry cell such as is used for ringing door bells and for ignition in automobiles. The new tube has become so popular that the storage battery may be practically eliminated in amateur radio in the future.

"B" batteries, being composed usually of dry cells, have been much less troublesome. They are comparatively light and compact. A fresh one may operate satisfactorily for months, without attention. Its operating life is nearly or quite as long as its life on the dealer's shelf. However, they have not escaped criticism. Time was when all the noises that interfered with the clear reception of radio concerts was charged to "static" or to the transmitters of radio amateurs, but recently some experimenters have insisted that the dry-cell "B" battery makes some of the racket. So there have entered the market a number of storage "B" batteries. They are not heavy and bulky like the "A" batteries that work on the same principle, but are made up of a dozen or more small cells. Sometimes ordinary test tubes are used to hold the solution and electrodes. Those who have tried the storage "B" batteries claim that they are noiseless and that the small expense and trouble of upkeep does not offset their advantages.

The question often asked by beginners: "What battery shall I buy?" is as difficult to answer as the question: "What kind of a girl shall I marry?" Tastes and requirements differ. Some persons judge almost entirely from appearances. These will be attracted by silver name plates, bright nickel trimmings and other ornamentation that has nothing whatever to do with the service or life of a battery. Other purchasers demand good materials and good workmanship and will not buy until they know what is inside the battery, no matter how well it may look outside. This is the wiser plan.

The weak points of a storage battery are the containers that hold the solution. Apparently all the suitable materials that resist sulphuric acid are brittle. Glass and hard rubber are most commonly used. One battery that I purchased developed a leak very soon in spite of the fact that I carried it myself most carefully to and from the charging station and never subjected it to any rough usage. Another fell from the running board of an automobile going twenty-five miles an hour, bounced end over end for a rod and then slid far enough on its lead terminals to scrape off the plus and minus signs. The accident did not interfere in any way with the operation of the battery that day or later. The containers must have been extraordinarily well installed and supported.

A "B" battery may as well be run to exhaustion if it is of a type that is not re-chargeable, but a storage battery should never be used after its power is perceptibly weakened, because such treatment permanently injures it. A storage battery must be kept filled with distilled water, so that the lead plates in the containers are covered. None but distilled water is safe. Any other water may contain substances that will prevent the battery rendering its best service. Water is almost as fatal to a battery as wood alcohol is to a human being when taken internally.

If the battery is charged at home it must be watched to prevent overcharging, which may heat and warp the plates. The best tests are made with the hydrometer which shows the specific gravity of the solution. This device can be used by a beginner without difficulty, being as easy to read as a thermometer. It costs little.

Beginners are not usually equipped with voltmeters and ammeters that show the exact characteristics of the circuit connected to the filament and the voltage placed upon the plate by the respective batteries. It matters little to the man who is merely playing with his radio outfit, listening to anything that happens to come in, but the man who wants to develop himself and his station to the point where he can listen in for a certain station and get it in spite of distance or interference must provide instruments that will enable him to do accurate work. Recording or remembering the setting of a rheostat knob is not sufficient, for the condition of the battery may vary from day to day. Today the variable "B" battery may give best results when you tap in at the contact marked "16½ volts." Tomorrow you may have to move up to 18 or 19½ volts.

Dry cells used for lighting filaments give more hours of service if they are used only an hour or less at a time and then permitted to rest for a day. A man who uses a WD-11 tube, for example, three or four hours a day, will save batteries and money by buying half a dozen dry cells at a time and using them from a half hour to an hour each in rotation instead of drawing current from one for the whole time.

Beginners sometimes pick up for their first experiments second-hand equipment that has reposed in somebody's attic for years while the science of radio has moved onward. Such a one may acquire a crystal detector that needs the assistance of a dry cell. Galena is the crystal most commonly used by amateurs today. It requires no battery. But carborundum, which is still used on shipboard to some extent, needs a dry cell or two to push the signals through it. Any ordinary dry cell—No. 6 is the common size—will answer the purpose. For best results it must also have a potentiometer to adjust the strength of the current to the requirements of the crystal.

Attractive bargains in Government batteries have been advertised for some time. For example, storage batteries that retail at $120.00 have been sold as low as $18.50. If in good condition they are good bargains, but any battery that has been lying around for months or years needs to be carefully scrutinized by someone who knows batteries before it is purchased. A battery in use will sometimes last longer than one that has long been idle.

There is a well known type of storage battery that uses an alkaline instead of an acid solution. It is exceedingly well made and has been known to last ten years or longer, while the guaranteed life of acid batteries is usually two years or less. The criticism heard concerning this battery is that the amount of current that can be taken from it after charging is much less than the acid battery delivers. It needs more frequent charging.

Land line telegraphers often ask if the wet cells used in their work are adaptable to radio work. Generally speaking, they are not, for they do not show the voltage, amperage and service characteristics of the radio types of batteries.

(*Continued on page* 1211)

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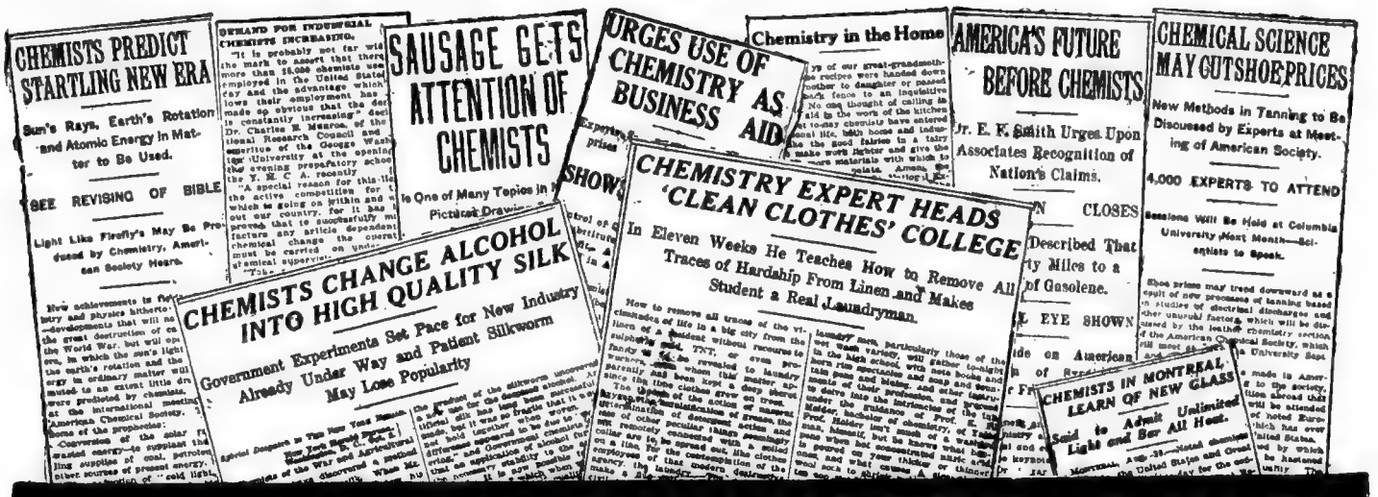
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The United States Needs Chemists

What did America get out of the War? You often hear that question asked, yet few people realize just what material advantage the United States did gain. She gained industrial supremacy. Hundreds of manufactures formerly almost unknown here, have come to this country to stay. With hardly an exception they belong to the so-called Chemical Industries, for which the services of trained chemists are essential. The dyestuff industry alone gives employment to thousands of chemists, for whom there was little demand prior to 1914. Outside of the laboratory there are innumerable executive positions which can be filled only by men who understand chemistry.

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Did you know that carborundum, the universal abrasive was unknown until E. A. Acheson, another American chemist, discovered it in 1891?

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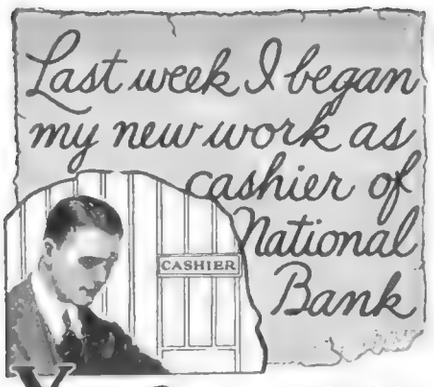

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My Visit To A Modern Battleship

By H. WINFIELD SECOR

(*Continued from Page* 1159)

ing electricity for auxiliary requirements, such as lighting, radio, motors for turning the gun turrets and driving ventilation fans, etc.

The *Maryland* has eight oil-fired boilers, the fuel oil being forced through the nozzles into the fire box under a variable pressure, depending upon the air pressure in the boiler rooms, etc., these factors being controlled either from the boiler room or else from the main switchboard. The fuel oil capacity is 1,400,000 gallons.

One of the most interesting features of a modern warship like the *Maryland* is that no fresh water whatever is carried when she leaves port and starts on a cruise. All of the water including that for drinking and boiler use, is condensed from sea water. The steam evaporators are capable of producing 40,000 gallons of water per day. Salt water is not used of course, in the boilers as this would produce foaming and a tremendous amount of scale in the boiler tubes, thus lowering the efficiency of the boilers very rapidly.

An elaborate refrigerating system is installed among other pieces of machinery which takes care of the cold storage rooms, in which meat and other perishable foods are stored, cold drinking water, etc. The battleship *Maryland's* cold storage refrigerators can take care of fifty tons of meat, which along with many tons of other foods, are necessary in feeding her normal crew of 1,400 men, three times a day. The *Maryland*, at the time of my visit, carried some extra men to be placed aboard the various under-manned ships at the maneuvering grounds or about 1,800 in all.

AIRPLANE AND RADIO

We saw two large sized, able looking seaplanes lashed fast to the upper deck, which the officers explained were to be used in spotting shots fired at a target beyond the horizon. These seaplanes are equipped with radio transmitting and receiving sets, so that they can transmit back to the mother ship whether the shots were falling short of the target or beyond it, etc. The *Maryland* carries on the aft deck one of the latest launching devices for aircraft, known as a *catapult*. This catapult measures about fifty feet long, and a seaplane is placed on it with the aid of one of the ship's huge electric cranes. These cranes, are also used to haul the seaplane out of the water when it lands after completing a reconnoitering flight.

The naval aircraft carrier *Langley* is fitted with steel piano wires, as explained and illustrated in this journal, whereby the airplanes can land and stop in a short distance on her larger upper deck, but there is not sufficient space anywhere on the structure of such a powerful sea fighter as the *Maryland*, for the necessary wires and weights for landing and stopping a plane, unless these are developed to occupy a good deal less space than that at present occupied on the aircraft carrier, the *Langley*. When the seaplane is mounted and secured by quick release triggers on the sliding carriage atop the catpult, and when the catapult has been turned to face the plane into the wind; and when the aviator has tuned up his engine, and has tried it out and has the propeller going at a given rate of speed, the signal is given—the officer in charge presses a button, and compressed air at six hundred pounds per square inch rushes into the long steel cylinder within the catapult, which causes a piston within it to travel like lightning to the other end of the cylinder, drawing along with it a cable fastened to the truck on which the seaplane is mounted. Result—the seaplane and its pilot are shot along the fifty foot catapult so rapidly that when the release triggers hit the pins on the end of the catapult frame, the seaplane flies off in the air at the rate of fifty miles an hour.

A visit to the main radio operating room, well below the top decks, so as to be amply protected, discloses a great many new features which we land-lubbers had never dreamed of. In the first place, the *Maryland* had a host of different aerials of several sizes suspended from her masts. Without going into detail, which space forbids, it may be said in the latest developments, and with several operators on duty simultaneously, as many as six different radio messages can be received on different wavelengths at the same time, while an improved system is used whereby the dots and dashes of incoming messages can be received in between the signals transmitted from the ship itself. Not only this, but in battle action it is possible to use directive radio sets and transmit two different messages fore and aft for communication with other vessels in the fleet, while the main transmitter is in operation and also while receiving is going on.

At one side of the main radio room there is a sound-proof room built just like your butcher's ice box, in which one or two operators can sit and listen in for long distance messages. One of the main transmitting sets on the *Maryland* is of the arc type, while another is of the quenched gap type. There is also an emergency two kilowatt quenched gap transmitter in a lower hold, with antenna wire, etc., so that in case the ship should be badly damaged in battle, this emergency set can be rigged up and messages sent out giving her position and condition, etc. The Admiral of the fleet talks to the Navy Department at Washington every day, no matter where the vessel is located on the high seas, his telephone being connected through the radiophone transmitter in the main radio room. Thus it is seen that radio as we read it in the magazines and "as she is" actually aboard a modern naval vessel, are two quite different things.

Thus the officers on board a ship like the *Maryland* can in a few moments have radiograms placed in their hands from seaplanes, destroyers, other battleships, from land, and also from submarines, all these messages having been picked up and interpreted by the Navy operators at the same time. Thus the officers in charge of the ship, and the Admiral in charge of the fleet, have some man sized job on their hands when such a vessel as the *Maryland*, or a group of modern war vessels, get into action.

BIG GUN FEATURES

The *Maryland* is a two fisted fighter and is armed with a main battery of eight 16" guns mounted in two gun turrets, provided with heavily armored barbettes as the accompanying sectional view of one of the main turrets in action shows. Each of these huge 16" guns measures fifty-seven feet in length. The 16" shell is about four feet in length, and weighs 2,100 pounds, or about one ton. The average range of these guns with accuracy, is twenty miles, and targets have been hit regularly at seventeen and one-half miles. Asked regarding the number of shells carried for each of these large guns in the magazine far below the gun deck we learned that from three hundred to four hundred shells are carried for each gun. After the shell has been forced into the

(*Continued on page* 1206)

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My Visit to a Modern Battleship

(*Continued from page* 1204)

breech of the gun by a telescopic rammer, several bags of powder are placed in behind it, the total charge of powder being four hundred and eighty pounds. The breech block is then swung into position, given a partial turn to lock the thread, and the gun is ready for aiming and firing. Almost unbelievable is the fact that these big guns can be handled rapidly enough to fire as many as three or five shots a minute, and remember there are eight of them and they can be all trained to fire a broadside salvo. Such a wonderful gun platform is the *Maryland* and other modern ships of her type, that there is very little roll even when all of the main battery guns are fired simultaneously in a salvo, and there is very little smoke, also, thanks to the smokeless powder used. Of course there is a heavy flash from each gun, but the heavy black smoke seen in moving pictures, is due to the yellow gases liberated when firing and which photograph black.

The *Maryland* carries a secondary battery of fourteen 5" guns, and also eight 3" anti-aircraft guns for fighting off enemy torpedo vessels and aircraft.

As regards torpedo attack, the officers of the *Maryland* are pretty confident that they can withstand an ordinary attack, as she is heavily armored on both sides, and besides there are four coffer dams and a double skin in which the oil fuel is carried. Over the engine room and other important parts of the ship, there is a protective armor 4" thick, to take care of aircraft bomb attacks or shells, which may land on the decks and attempt to work their way inward and downward, which is one of the greatest concerns of the naval fighting men.

As one of the accompanying illustrations shows, one of these big gun turrets in action is one of the finest expositions of engineering that one would want to look at. The turrets may be turned in any one of four ways, that is, by hydraulic motor, pneumatic motor, electric motor, or by hand gear. The turret crews are of course drilled in general practice, with all of these various means of training the guns. The big guns can be raised or lowered or trained in four ways; also these various provisions being necessary as one or more of them might fail at a critical moment or be put out of commission by an enemy shell.

In the battle of Jutland a German shell landed on a thin roofed turret of a British battle cruiser. It found its way down an ammunition hoist, and exploded in the magazine and the ship went to the bottom in less than five minutes. To avoid repetition of this, the turrets are now being provided with heavier roofs and there are several armored doors in the ammunition hoist-way. The shells and powder are loaded from the respective floors upon the ammunition hoists which resemble dumbwaiters, and when they reach the top of the shaft, they are rolled on the tray or the shelves by the gunners. A number of shells are thus always kept in reserve on the shelves. Loud-speaking telephones as well as speaking tubes run all over the ship and orders are given in the different sections with machine-like accuracy and precision, and everything works like clockwork.

The range of the enemy is accurately determined in one of several ways, the commonest of course being by means of a range finder. On the newer ships, or at least on the *Maryland*, the main big gun turrets have a range finder built right in the backs, the lenses at either end projecting from the sides of the turret and turning with them. There are also directorscopes on top of the shell-proof cage masts, and in the armored conning tower. These range finders operate on the principle of triangulation which we used to study in geometry in our school days and it is surprising how accurately an enemy target can be spotted at ten to fifteen thousand yards or more.

Dr. Hackensaw's Secrets

By CLEMENT FEZANDIÉ

(*Continued from page* 1169)

The thing is an absurdity, and no scientist at the present day would dare to propose such a theory. But I am digressing.

"Sound waves consist of merely a few vibrations per second, while light waves consist of many thousand vibrations per second. Between the highest sound our ears can perceive, and the ultra-red or heat rays of the spectrum, there is a considerable interval which is altogether unknown to us. Next come the light rays, ranging from the slower red rays to the more rapid violet rays, seen when light is decomposed, as in a rainbow. Beyond the violet rays we come to the so-called invisible actinic rays. These *we* cannot perceive with any of our senses, though Sir John Lubboch's experiments seem to show that ants can feel them, for the ants always remove their eggs when these rays are thrown upon them. Next to these invisible actinic rays, which, by the way, are the rays used in photography, there come other unknown intervals *until we* come to the wireless waves used in radio work.

Here Doctor Hackensaw paused, and then, after a moment resumed:

"My first problem was to find some means of making these unknown waves perceptible to us in some way. As you may perhaps know, Gloria, the audion, practically considered, transforms the excessively rapid vibrations of the wireless waves into the slower vibrations perceptible to us as sounds. This being the case, there was no reason why an audion, if properly constructed, could not be made to do the same thing for the unknown waves, or indeed for waves with any number of vibrations per second. In other words an audion could be built that would change either actinic waves, light waves, heat-waves or any other waves whatever into sounds. Experiments proved the correctness of my theory. I began by transforming light waves into sound waves by means of a specially designed audion. I have here an instrument by means of which I can *hear* light. And the sounds produced by blue light differ from those produced by green light, red light or any other colored light. By means of this instrument a blind man can be taught to name the different colors in a painting by *listening* to the light waves that emanate from it. He does not, of course, visualize the colors blue, yellow and red, etc., but my instrument enables him to realize the shapes of the figures in the painting, the persons, trees, houses, etc., for the sense of touch has already taught him to understand shapes. To him therefore all pictures appear as if they were in black and white. The instrument also enables him to read our books as well as enjoy the pictures in them."

"I don't quite understand how sounds can produce shapes," interrupted Silas.

"The idea of shape is produced by the

(*Continued on page* 1208)

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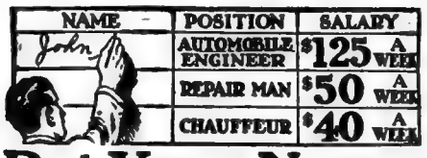

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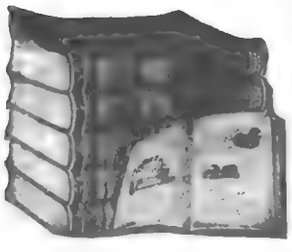

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by .....

Dr. Hackensaw's Secrets

(*Continued from page* 1206)

fact that the sound waves arise from different parts of the picture. Just as we obtain the impression of the forms in a picture because the light waves arise from different points, so, by the use of my apparatus can we obtain the same impressions of form because the different sound waves come from different points. A blind man can therefore soon learn to *hear* a picture correctly. But you can test the instrument for yourselves. Just place these phones on your ear, Miss Gloria."

"All I hear is a curious rumbling," said she, "something like the confused buzzing in a telephone."

"That's because you haven't learned to understand the sounds. A baby has to learn how to hear and how to see, and likewise an adult must learn how to use this instrument before he can properly interpret the sounds. What you just *listened* to, is a reproduction in colors of one of Raphael's celebrated paintings. My instrument here can be tuned to change any vibration whatever into sound waves. I merely move this slide along the coil of wire until the proper spot is reached.

"This much accomplished, I next sought to reverse the process which I solved successfully. Put on these spectacles, and you will find that you can *see* sounds!"

With these words, the doctor passed the young lady an instrument that looked more like odd-shaped opera-glasses than spectacles, and which was connected by a flexible wire cord to another electrical apparatus.

"In the first experiment," continued the doctor, "I shall have the music played in the next room." Here he pressed a signal button, and then turning to Gloria, asked: "Now, what do you see?"

"I see all kinds of flashing things and funny colors," replied Miss Gloria.

"Very well. What you saw was a tune played on the violin by one of my assistants in the next room. I shall now ask him to step in here, so that you can *hear* the tune he plays at the same time that you *see* it."

It was a most peculiar sensation the young lady experienced as she looked through the instrument and perceived the colors and forms varying with the varying sounds of the instrument.

"All this was but the first step in my investigation," resumed the doctor. "To enable a man to *see* with his *ears*, or *hear* with his *eyes*, was nothing but the preliminary stage. I wished to go further and give him at least one new sense—perhaps several."

"But," interposed Silas, "I thought you said your instrument would enable him to perceive any number of vibrations per second at will?"

"So it does, but it translates these known or unknown waves into either sights or sounds. This instrument therefore does not furnish us a new sense, but merely enables us to perceive hitherto unknown waves with our old senses.

Doctor Hackensaw smiled then continued: "Well, as I was saying, I was not satisfied with a mere translation. I was seeking for a new sense, and I have found it!"

Here he paused for a moment impressively and then continued:

"As I told you before, it is impossible for me to give you any idea of what this new sense is like. But the instrument is here and you can try it for yourself. For

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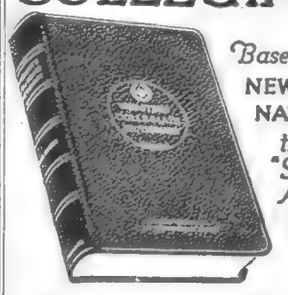

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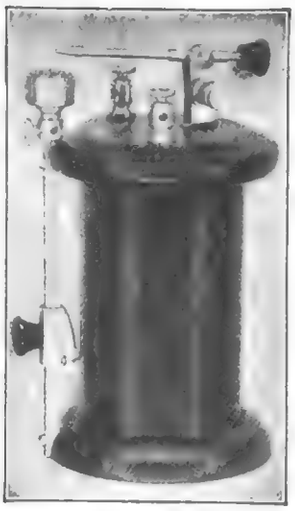

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my part I can sit here for hours and enjoy the new sensations in a state of perfect rapture. You will find that a new world has opened for you, and I prophesy that, from now on, you will both be daily visitors here, until I make you a present of an instrument for yourselves.

"Before I turn on the current, however, I must tell you a little more about the steps I followed in making the invention. I followed the well-established principle of proceeding from the known to the unknown. I knew something about sight and hearing, so my first efforts were made to enable us really to *hear* with the *eyes* and *see* with the *ears*."

"But," objected Silas, "that is just what your instrument does."

"No, Silas. The instrument you have tried simply translates sights into sounds or sounds into sights. It enables us to *see* sounds with our eyes or *hear* pictures with our ears. It does not enable us to *hear* sounds with our eyes or *see* pictures with our ears. And this was what I was seeking. I soon realized that this would be impossible. The eye and the ear are too highly specialized to be used for other purposes. The crystalline lens and the retina of the eye are not adapted for receiving sounds. And the tympanum (or drum), and the bones of the ear are not adapted for photographing images. Even the auditory nerve and the optic nerve are too highly specialized to be interchangeable, as I convinced myself by experiments. My only hope therefor lay with the sense of feeling—our fundamental and least specialized sense. All our special senses—sight, hearing, smell and taste were all evolved from the sense of feeling, hence the nerves of feeling must contain to a certain degree the power to transmit sound waves and light waves to the brain. The clam has no eyes but can perceive shadows—the ordinary earth-worm has no eyes, but can perceive light. These facts gave me hope.

"As the finger tips are the most sensitive portions of the body, it is these I use as my receivers. I shall not weary you with an account of my experiments. Let me show you the result. I have here a small instrument made somewhat on the plan of a human eye, with its adjustable lens, its humors, and its retina. Instead of the rods and cones of the eye and the 'visual purple' I use a chemical preparation which does the retina's work of receiving the image—for the human retina is but a photographic plate where images are received. In the real eye the image lasts but a moment, so I pad to find chemicals which would likewise be changed for a single moment, and then resume their original state again ready to receive new images. A careful study of the visual purple in the eyes of animals enabled me to do this.

"There is my artificial eye. It is, as you see, fastened to one of the finger-tips of a glove. Please put on this glove, Miss Gloria, then point the finger at one of the paintings on the wall, and close your eyes."

"Why, I can see it almost as well as with my eyes open!" cried the young lady, in astonishment. "I can see all the colors and all the figures."

Silas tried it in turn and was delighted with the instrument. Then Doctor Hackensaw dived down and produced from his desk a second glove with a pecularialy shaped appendage to one of the finger-tips.

"This," said he, "is an artificial ear, and is used in the same manner as the eye. Put this on your hand and stop up your ears."

Miss Gloria obediently did as she was bid, and Doctor Hackensaw sat down at the piano and played a lively jazz tune. The young lady found that every modulation of sound reached her, through her finger-tips amost as well as through her ears. When

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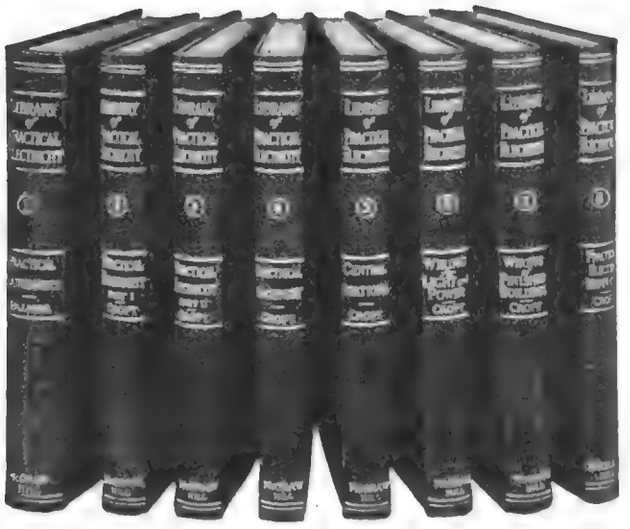

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she used both the instrument and her ears at the same time, the sounds were practically doubled in intensity.

"This is an amplifying device of my own invention," observed the doctor, smiling. "With an ear on each finger-tip of a pair of gloves, I can increase a sound to ten times its original intensity. With an eye on each finger-tip I can intensify light in the same way. I can see better in the dark than a cat can, and I can save nine-tenths of my electric light bills."

"Doctor!" cried Silas, "If you had been born in the middle ages, you would have been burned as a sorcerer!"

"Well," resumed the doctor, "I won't weary you by going into further details. Suffice it to say, that I have an artificial nose by which I can smell with my finger-tips, and an artificial finger-palate by which I can taste food without eating it. I find this useful in detecting chemicals which I should not dare to put into my mouth.

"My next step was my hardest. So far I had been helped by the knowledge I possessed of human organs. Up to this point I had a guide in constructing artificial eyes, ears, nose and palate. But I had no such help to guide me in making my sixth sense. Photography, it is true, gave me an inkling of how to make the actinic rays perceptible; and the fluorescent screen gave me the clue as to how to proceed for the radio-active waves, but it took me months of laborious experiment before I succeeded in creating my *'sixth sense,'* which I have christened the 'radio-actine' sense. There is the instrument. Place it on your finger, Miss Gloria, and see what you think of it."

Gloria Mundy took the glove-like contraption handed to her, and drew it on her hand. For a moment she stood in expectation, and then a look of wonder and delight came into her eyes, and she felt a sense of ecstasy such as she had never before experienced in her life

"Well, how do you like the sixth sense?" asked Doctor Hackensaw, beaming with pleasure.

"It's marvelous, doctor! I never knew anything like it. Why did you stop the harmony? Please go on with it. What was it, anyhow?"

"These are radio-active waves that you perceive," explained the doctor, and you perceive them neither as flavor, scents, sounds or visions, but in an entirely new and hitherto undreamt of manner. What you have been listening to is a radio-active harmony of my own composition—not music, understand—but a harmony of radio-active waves."

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Mr. H. W. Hoops, of Montclair, N. J., whose process for hardening different metals was described some time ago in this journal, recently showed the editors some samples of the work he has accomplished in his latest researches, viz., that of pure hardened aluminum. This aluminum, which Mr. Hoops explained, was absolutely pure aluminum stock and contained no alloyed metal whatever, was extremely hard, but not brittle. Mr. Hoops believes that his secret method of hardening aluminum so as to make it as tough as the strongest specially treated steel, will revolutionize the building of aircraft. He stated that experts in the aluminum and aircraft industries, who had examined his samples of hardened aluminum, had pronounced them the greatest surprise they had ever anticipated in their wildest dreams. The inventor explained that he had added no metals to the aluminum, thus making it an alloy, and that the pure hardened aluminum could be turned out in twenty minutes time, and further that his process is not dangerous. A very high temperature is necessary in accomplishing this change in the aluminum, an electric furnace being very desirable for carrying out the work.

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Radio for the Beginner

(*Continued from page* 1202)

Automobile batteries are used for lighting electron tube filaments though they usually differ in some respects from batteries made especially for radio purposes. The radio battery may be built for much slower charge and discharge than an automobile battery. The owner of a radio storage battery should caution the manager of the charging station to which he takes it; otherwise it may be injured by being charged at the same rate as the auto batteries.

Many batteries have terminals that are convenient for some purposes, but troublesome in radio. A copper wire connected to a lead terminal usually becomes covered with a greenish substance that makes it disagreeable to handle. Battery clips are easy to adjust to suitable terminals and it is better to depend upon them than upon thumbscrews or other connecting devices on the battery.

Switches on the radio receiver are supposed to cut off the juice and save the batteries when not in use, but disconnecting one wire from the battery and fastening the end somewhere in a manner that makes accidental connection or short circuit impossible will save unpleasant experiences.

Storage batteries should be placed on or in something that will take care of any leakage that can possibly occur. A small leak will soon saturate the thickest cardboard and even penetrate a board in the course of time. A very small quantity of battery solution will ruin a carpet or fine woodwork. A lead drip pan filled with soil, sand or sawdust serves as an absorbent support for storage batteries.

Dry cell batteries should be tested before purchasing, and the manufacturer's shelf-life guarantee should be noted also, for manufacturers assume no responsibility for the condition of such batteries beyond a specified date. A shelf-worn battery may show the proper voltage when a volt meter is applied for a moment and still not last long when attached to a radio receiver.

A dry battery can be used to assist a storage battery that runs down at the most thrilling moment of the radio show. For example, disconnect the positive, or plus, terminals of the storage battery from the positive terminal on the radio receiver, and connect a single No. 6 dry cell with its positive terminal to the positive terminal on the receiver and its negative terminal to the positive terminal on the storage battery. The dry cell will not last long, but it is sometimes worth half a dollar to get the fifteen minutes of the performance that you are specially interested in.

If the matter of polarity is in doubt—and it often is, for the battery makers know the poles so well that they often neglect to mark the poles plainly for the rest of us—dissolve a teaspoonful of salt in a glass of water and put the wires from the two poles of the battery into the solution. The bubbles rise thickest from the negative wire. Mark the battery terminals plus and minus after you have determined the polarities.

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Mrs. Gowen, in owner's cabin, writing up the log of the cruise on her Remington Portable

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Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page* 1175)

meteoric size exist extensively in interstellar space it may be asked what are the chances of collisions between the stars and these cosmic clouds? In general the particles of which these cosmic clouds consist are so finely divided that our own sun or other suns of space would pass through stray wisps of these clouds or their less dense portions without any noticeable effects either on the sun or its planets. It has been suggested, though, that possibly the cause of the glacial and interglacial periods has been the passage of the sun and its planets through regions in which the cosmic dust has varied considerably in density. Also it is possible that the encounter of the sun with the denser central portions of one of these cosmic clouds, or possibly its passage through one of the absorption rings that apparently extend to enormous distances from some of the stars, would produce disastrous results, for its satellites at least, owing to the friction that would be produced.

The explanation of the outbursts of novas or temporary stars that is most generally accepted is that an encounter of a star with a dark nebula takes place which temporarily increases the luminosity of the star many thousand-fold within a period of a few days. In many instances the presence of a surrounding nebulosity has been revealed after the encounter by the reflected light of the star though it is probable that there is also an actual expulsion of finely divided matter from the star itself at the time of the catastrophe due to the sudden increase in radiation pressure.

Twenty or thirty years ago it was considered that the outburst of a nova was an extremely rare occurrence, but within the past few years, since a systematic search has been undertaken for novas on photographic plates of the Harvard College Observatory, it has been estimated that all the stars in the heavens have probably passed several times through the nova stage. If the present rate at which novas are appearing has been maintained throughout the past ages several times as many such outbursts have occurred since the probable origin of the earth as there are now stars in the heavens. The conclusion seems to be inevitable, then, that our own sun has passed several times through the nova stage in its past history and will do so again at some time in the future. Though the encounter of the solar system with a cosmic cloud dense enough to produce a solar outburst of the nova type would destroy all life on its planets in the twinkling of an eye it is more than likely that the sun itself would not feel the effects of the catastrophe except at the surface, and would go on its way with slightly diminished splendor, though surrounded for some time to come by the debris of shattered worlds. Judging from the present orderly state of the solar system many aeons have passed since our luminary has experienced any serious encounter with the cosmic clouds of interstellar space.

X-RAYS FOR WHOOPING COUGH

Belief that X-rays may prove of more value in treatment of whooping cough than any other remedy is expressed by Dr. Henry I. Bowditch and Dr. Ralph D. Leonard in a preliminary report on experiments to find a cure for the complaint, which has baffled all treatment. Their report said definite improvement was noted in most of twenty-six active cases treated with X-rays.

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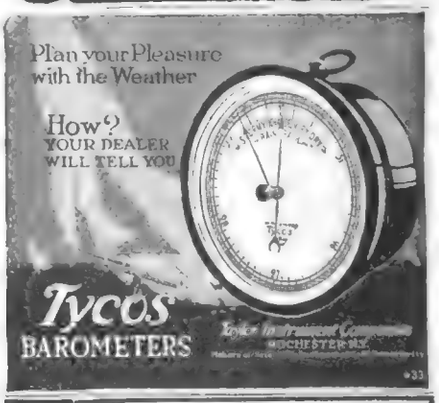

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See how they sparkle and flash! We defy you to tell the difference. Choice of gold or white platinum finish setting.
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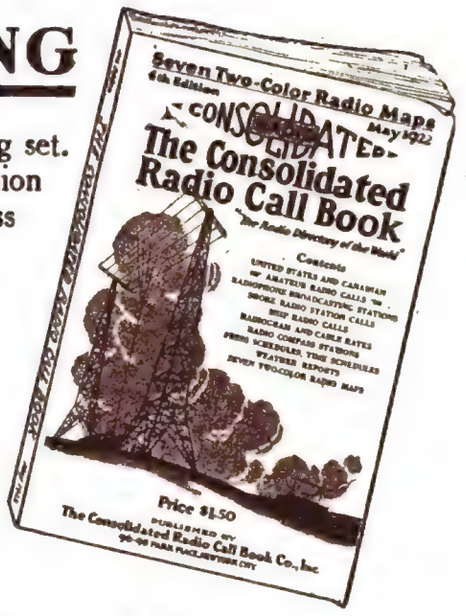
KNOW WHO IS SENDING

Get twice the pleasure and usefulness out of your receiving set. Look up the name and location of any ship or land station whose messages you pick up—learn the name and address of that amateur whose sending set you just heard.



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And every vessel and land station in the world is represented and listed alphabetically, according both as to name of vessel or land station, and to call letters. The Consolidated Radio Call Book is the only book in print officially listing all the Radio calls as issued by the Bureau of Commerce. And the New Radiophone Broadcast Section is particularly complete and gives all available information concerning calls, wave lengths, PROGRAMS, etc.

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PLATE CIRCUIT "B" BATTERIES

You can make real savings on these batteries. Don't pay more. We guarantee them to equal any on the market regardless of price. Absolutely uniform. Extra long life.

Z180 Signal Corps type, small size, 15 cells, 22½ volts. Each....95c

Z184 Variable Large Navy size, 6½x4x3 inches 5 taps, giving range from 18½ to 23½ volts in 1½ volt steps. Each.....$1.80

Z186 Combination Tapped 45 volts 30 cell, 13x4x3 battery. Tapped to give 45, 25½, 21, 19½, 18 and 16½ volts. Handles both detector and amplifier tubes. Each.....$3.55

HOMECHARGER BATTERY CHARGING RECTIFIER

Charge your battery at home over night for a few cents. Simply connect to any 110 volt 60 cycle light socket, turn on current and rectifier does the rest automatically. Will work for years without attention. Simple connections. Given a tapering charge which batteries should have. You can make it pay a profit charging your friends' auto batteries. Long connecting cords with pair of battery clips.

Prices are Transportation Paid.

Z201 For 6 volt battery.....$13.95
Z203 For 12 volt battery.....13.95

STORAGE "A" BATTERY

A very high grade battery made expressly for radio service. Guaranteed for three years. Properly cared for will give many more years of service for filament lighting. Made of best new materials. Full capacity. The best battery buy on the market. Try one of these batteries on your set for 10 days. If at the end of that time you are not fully satisfied with the battery return it and we will refund the purchase price.

Z194 6 volt, 40 ampere size. Each.....$10.00
Z196 6 volt, 80 ampere size. Each.... 12.50

BATTERY CLIPS

Z199 Two for 20c

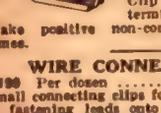
Clip onto storage battery terminals, lead coated. Make positive non-corrosive contact at all times.

WIRE CONNECTING CLIPS

Z190 Per dozen 30c

Small connecting clips for quickly fastening leads onto binding posts, etc. Handy and useful. Every radioist should have at least a dozen.

PORCELAIN BASE SWITCHES



Fine white porcelain bases. Copper contacts and blades. Can be used as antenna switches.

Z385 Single Pole Single Throw. Each 20c
Z387 Single Pole Double Throw. Each..32c
Z384 Double Pole Double Throw. Each..50c

FILAMENT CONTROL RHEOSTATS

Cresley—Wound on vulcanized fiber. Adjustable to any panel. Complete with knob.

Z130 Each 45c

Best grade. High heat resisting base. Diam. 2¼ in. cap 1⅝ amp. Resist. 6 ohms. 1¼ in. knob with pointer. 75c value.

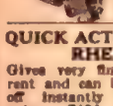
Z132 Each 45c

POTENTIOMETER

Same style as above rheostat. Gives fine "B" battery adjustment. Resistance 200 or 300 ohms

Z133 Each 90c

VERNIER RHEOSTAT

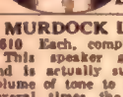


Gives exceedingly fine control of "A" battery current. A necessity for best receiving results.

Z135 Each 75c

QUICK ACTING VERNIER RHEOSTAT

Gives very fine control of current and can be switched on or off instantly at any desired point. Z124 Each $1.19



Porcelain Base Rheostat for table mounting. Resist. 10 ohms.

Z136 Each 75c

MURDOCK LOUD SPEAKER

Z610 Each, complete $4.75

This speaker gives excellent results and is actually superior in quality and volume of tone to many others selling at several times the price. You will be pleased with it. One of the best radio values ever offered. Black moulded base. Reproducing unit directly attached to aluminum sound chamber. Fibre amplifying horn. Five foot connecting cord included.

MAGNAVOX LOUD SPEAKER

Z612 Each $34.50
Model E3 genuine Magnavox.

WORKRITE JR. LOUD SPEAKER

Z614 Each $10.80

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Standard Brands—Cunningham Radiotrons. Every one guaranteed new and perfect. We will ship brand in stock unless you specify otherwise.

Z105 Detector, UV200 C300 Ea.$4.30
Z110 Amplier UV201 C301 Ea. 5.85
Z118 5 Watt Transmitter 7.20
Z107 WD11 1¼ v. Fil. Each.....
Z108 WD11 Socket. Each.....
Z109 WD11 Adapter. Each.....

FOUR-IN-ONE SCREW-DRIVER

Z974 Each 55c

Especially suitable for radio work. Will handle any size screw used. Smaller drivers nest inside larger one and are held in place with screw cap. Made of steel, nickel finished. Every radio builder can use several of these handy tools.

VACUUM TUBE SOCKETS

Our Special Socket. A wonderful value. Moulded entirely of brown bakelite. Four binding post connections. Right angled contact springs.

Z140 Each 35c

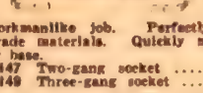
PORCELAIN BASE AND TUBE

Z144 Cresley for either panel or table mounting 30c

High Grade combination type for panel or table mounting. Metal tube. High insulation base. One of the best sockets made.

Z146 Each 45c

TWO AND THREE GANG SOCKETS



These sockets make it easy to build detector and amplifier units and make a neat, compact workmanlike job. Perfectly made of high grade materials. Quickly mounted on panel or base.

Z147 Two-gang socket $1.05
Z149 Three-gang socket 1.45

FIXED CONDENSERS

Moulded cases, nickeled binding posts.

Z804 Each 40c

CARBON PRESSURE VERNIER RHEOSTAT

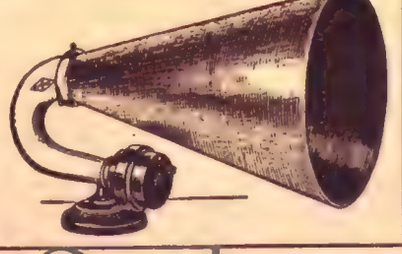
Current regulation is obtained by changing of pressure on carbon. This permits of infinitely fine variation of current. Very durable. Resistance 15 ohms. Capacity 2½ amperes.

Z131 Each $1.65

RADIO TUBES

Tubes for winding coils. Strong solid material, with smooth clean surface.

Z950 Diameter 3 inches, per foot.....20c
Z951 Diameter 3½ inches, per foot.....25c
Z952 Diameter 4 inches, per foot.....30c



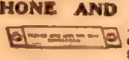
VARIABLE GRID LEAK

Pencil mark type. Resistance may be varied exactly as needed. Z160 Each.....19c

GRID CONDENSER

Z162 Mounting holes spaced to fit lugs of above leak. Cap. .00025 MF. 14c
Z163 Same as 162 but higher grade. Enclosed in metal case. 39c

PHONE AND GRID CONDENSERS



A compact style of condenser that is very satisfactory. Conducting sheets and dielectric are wound on fiber strip with eyelets for mounting and connections. Each 12c

Z170 Phone Condenser .001 Mfd.
Z172 Phone Bridging Condenser .0005 Mfd.
Z174 Grid Condenser .00025 Mfd.
Z176 Grid Condenser .00025 with pencil mark leak. Each.....24c

TUBULAR GRID LEAKS AND CONDENSERS—MOUNTED STYLE

Very convenient. Permits quick change of leaks or condensers of varying capacities.

Grid Leaks	Price Each
	.45c

Resistance		Resistance	
Z850	.5 Meg.	Z855	2. Meg.
Z851	1 Meg.	Z857	3. Meg.
Z853	1.5 Meg.	Z859	5. Meg.

GRID AND PLATE CONDENSERS

Price, each 55c

Z830 .00002? Mfd. Correct for Myers Tubes.
Z832 .0001 Mfd. For special circuits.
Z834 .00025 Mfd. For U.V.201 and Cun. 301
Z836 .0005 Mfd. For U.V.200 and Cun. 300

MOUNTINGS

Bakelite base. Spring clip contact.

Z840 Single mounting. Each.....32c
Z842 Double mounting. Each.....57c
Z844 Triple mounting. Each.....76c

"HONEYCOMB" COILS

Carefully made—fine looking coils. Highest efficiency. Low distributed capacity effect, low resistance—high self inductance. Very firm impregnation. Range given is in meters when varied with .001 variable condenser. Mounted coils have standard plug mountings.

Turns	Range	Art No.	Not Mntd.	Art No.	Price Mntd
25	120- 250	Z301	$0 39	Z320	$0.89
35	175- 450	Z302	.42	Z322	.96
50	240- 720	Z303	.49	Z323	1.04
75	390- 910	Z304	.54	Z324	1.08
100	500- 1450	Z305	.58	Z325	1.13
150	600- 2000	Z306	.63	Z326	1.17
200	900- 2500	Z307	.72	Z327	1.26
250	1200- 3500	Z308	.79	Z328	1.35
300	1500- 4500	Z309	.82	Z329	1.38
400	2000- 5000	Z310	.97	Z330	1.57
500	2800- 6100	Z311	1.12	Z331	1.63
600	4600-10000	Z312	1 27	Z332	1.78
750	5000-12000	Z313	1.43	Z333	1.93
1000	7900-15000	Z314	1.70	Z334	2.28
1250	9750-19500	Z315	1 92	Z335	2 49
1500	14500-26500	Z316	2.18	Z336	2.65

COIL MOUNTINGS

Z340 Three-coil mounting $3.45
Z341 Two-coil mounting $2.60

High grade fine looking mountings. Polished black composition. Center receptacle stationary, two outer ones adjusted by knobs. Takes any standard mounted coil.

COIL PLUGS

Made of moulded bakelite. Fits any standard plug. Mounts any standard honeycomb coil.

Z344 Each 50c

PANEL MOUNTING COIL PLUGS

Take any standard mounted coils. Made of moulded bakelite, mounted on brackets.

Z345 Stationary. Each.....80c
Z346 Movable with anti-capacity handle. Each $1.10

RADIO FREQUENCY AMPLIFYING TRANSFORMER

Z986 Very special $2.95

This transformer will get the long distance stations loud and clear. Permits of easy sharp tuning. Helps cut out static and interference. Makes your set sensitive enough to use a loop aerial. Enclosed in metal case affording perfect shielding. Suitable for panel or base mounting. Because of its special design can be mounted in any V. T. socket. Works with any style of tuner. Wave ranges 150 to 550 meters. Wiring diagrams included.

OUR SPECIAL AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

As high as three stages can be used without howling due to proper impedence ratio, minimum distributed capacity, low core losses and proper insulation. Mounted style has bakelite panel with binding post connections. Unmounted has core and coils assembled with two holes in core for fastening to apparatus.

Z234 10 to 1 Mounted. Each $3.40
Z235 10 to 1 Unmounted. Each 2.95
Z236 3 to 1 Mounted. Each 3.40
Z237 3 to 1 Unmounted. Each 2.85

THORDARSON AUDIO FREQUENCY AMPLIFYING TRANSFORMER

An especially high grade transformer with correct characteristics for Cunningham, Radiotron or A. P. Tubes. Wonderful results without distortion on one, two or three steps. Low distributed capacity. Fully mounted bakelite panel.

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Z233 6 to 1 Ratio. Ea. 4.15

RADIO CORPORATION TRANSFORMERS

Audio Frequency Amplifying Transformer. Especially designed for Radiotron tubes. 9 to 1 winding ratio.

Z712 Each $5.40

RADIO FREQUENCY AMPLIFYING TRANSFORMERS

Range 200 to 5000 meters. For long distance reception.

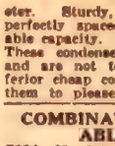
Z714 Each $5.95

OUR COMPETITOR AUDIO FREQUENCY AMPLIFYING TRANSFORMERS

While these are very low priced transformers, nevertheless they will give excellent results. They are carefully designed and carefully made. Quantity production and small profits make the low price possible. They will equal in results many transformers selling at much higher prices.

Z238 Unmounted, with wire leads.....$2.00
Z239 Mounted, with binding post connections, completely shielded...$2.75

BARAWIK SPECIAL PANEL MOUNTING VARIABLE CONDENSERS



Z812 43 plate .001 Mfd. ..$2.29
Z813 21 plate .0005 Mfd. 1.80
Z814 11 plate .00025 Mfd. 1.32
Z815 3 plate Vernier ... 1.05

These are especially high grade condensers and we guarantee them to be mechanically and electrically perfect. Fine polished end plates of heavy bakelite. Shafts ¼ inch diameter. Sturdy, heavy aluminum alloy plates perfectly spaced to insure smooth, even reliable capacity. Our low prices save you money. These condensers are of the very best make and are not to be compared with many inferior cheap condensers offered. We guarantee them to please you or your money back.

COMBINATION VERNIER VARIABLE CONDENSERS

Z824 23 plate .0005 Mfd. with dial and knobs. Price....$3.25
Z826 43 plate .001 Mfd. with dial and knobs. Price....$3.95

The latest improvement in condensers consists of regular variable condenser controlled by large knob and dial mounted with a three plate vernier condenser, which is controlled by separate knob mounted above knob on dial. This arrangement permits of very fine tuning. Compact convenient mounting on panel. High grade design and construction. Finely finished.

ENCLOSED VARIABLE CONDENSERS

One of the best made condensers. Rigid, accurately spaced aluminum plates. Formica ends. Engraved scale. Knob and pointer. Clear transparent case.

Z806 43 plate .001 Mfd. $3.95
Z808 21 plate .0005 Mfd. 3.25

KNOCKED DOWN VARIABLE CONDENSERS

You can save money by assembling your own condensers. Formica top and base. Complete with all parts not assembled. Go together easily and perfectly. Panel moulding type.

Z820 41 Plate .001 Mfd. $1.95
Z821 21 Plate .0005 Mfd. 1.60

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Will tune in all stations up to 3,500 meters. Very efficient on short waves and for radiophone reception. Used with our Detector Two Step Amplifier it produces very excellent results. Also does good work with crystal detector. Silk covered windings on formica tubes. Very fine mahogany finish wood work. Base size 6x18 inches. Slider controls primary, 12 point switch on secondary. Can be tuned very close. Brass metal parts nickel finish. A wonderful value at our price.

Z720 Price $6.39

TUNING COIL

Range up to 950 meters. Wound with bare copper wire, machine spaced. Ends of mahogany finished hard wood. Two easy sliding contacts on polished brass rods, four binding posts. Substantial, efficient, attractive. Length, 8¾ in.

Z722 Price $2.45

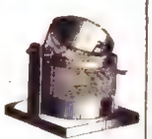
VARIOMETER

Z416—Completely assembled, price $2.69

Perfect in design and construction. Accurate wood forms of genuine solid mahogany. Correct inductive ratios. Solid baked windings. Positive contacts. Highest efficiency. A real bargain.

Z417—Not assembled nor wound but all parts complete except wire, including winding form, $1.49

VARIO-COUPLER

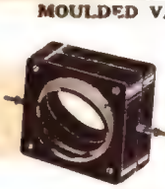


Z415 Price, completely assembled $2.45

With this loose coupler and two variometers, together with the necessary other parts, a highly efficient tuning set can be made. Easily mounted on panel. No base included. Primary winding on formica tube. Inductively coupled for 180 to 600 meters. Multiple taps permit fine tuning.

Z416 Not assembled nor wound but all parts complete except wire. Price.....$1.18
Z417 Rotor ball only. Each..... 29c
Z408 Bakelite stator tube only. Each... 35c

MOULDED VARIOMETER



Polished black moulded rotor and stator forms. Maximum inductance with greatest efficiency and minimum distributed capacity. A high grade durable instrument that will make up into a set you will be proud of and will get the best results. Wave length 180 to 600 meters. 4¾ in. square, 1⅞ in. thick.

Z412 Price including mounting brackets $3.95

MOULDED VARIO-COUPLER

This coupler is designed to work with the above variometer. The stator and rotor forms are of polished black moulded composition. Primary has seven taps to enable finest tuning. Wave length range 180 to 650 meters. Fitted with panel mounting bracket.

Z419 Price $3.78

IMPROVED 180° VARIO-COUPLER

Z418 Price $2.89

Our price shows you a big saving. An instrument of highest quality. The most efficient type of coupler, insures sharper tuning and louder signals. Primary and secondary wound on genuine bakelite tubes. Secondary connections through soldered flexible cables eliminates contact noises. Primary has 7 taps. Can be panel or table mounted. Range 180 to 650 meters.

BRASS ROD

Supplied only in 8 inch lengths.

Z961 Threaded 6-32, per 8 inch length... 8c
Z963 Threaded 8-32, per 8 inch length...10c
Z965 Solid 3-16 inch, per 8 inch length...10c
Z967 Solid ¼ inch, per 8 inch length....12c

TINNED COPPER WIRE

Size 14 tinned copper wire. For wiring sets. Best size for neat job and proper results.

Z969 Ten feet for 12c

CHOKE COILS AND RESISTANCES

For Super Regenerative Circuit

Z355 100 Millihenrie Iron core choke coil. Each $1.20
Z354 10 Millihenrie Open core choke coil. Each 92c
Z357 12,000 ohm Non-Inductive wire wound resistance. Each $1.58
Z356 12,000 ohm Moulded resistance. Ea. 45c
Z358 5 Millihenrie Open core choke coil. Each 92c
Z380 1 Henrie Iron core, choke coil. Ea. $1.20

BARAWIK QUALITY HEADSETS

These headsets have proven on rigid tests to be one of the very best on the market. The tone quality is excellent with an unusual volume. Skilled workmen make them from only the best selected materials. The receiver cases are fine polished finish with polished black ear pieces. Fabric covered head band comfortably and quickly fitted to the head. Supplied with 5-foot cord. These sets were designed to sell for much higher prices than we ask, and at our price are a wonderful bargain. We guarantee that you will be pleased with them and agree that they are the best value by far yet offered. If they don't suit you we will cheerfully return your money.

Z770 2000 ohm $3.75

OTHER STANDARD BRAND HEADSETS

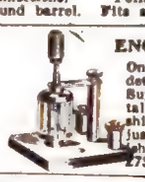
Z751 Murdock 66, 2000 ohm.....$4.20
Z752 Murdock 56, 3000 ohm..... 4.95
Z764 Frost, 2000 ohm 4.20
Z766 Frost, 3000 ohm 4.85
Z758 Western Electric, 2200 ohm..... 9.50
Z754 Baldwin Type C with universal jack plug $12.00
Z755 Baldwin Type C unit..... 5.50
Z756 Red-Head, 3000 ohm 5.78
Z768 Brandes, 2000 ohm 7.15

TWO-WAY ROUND PLUG

Z937 Each .....$.98

Takes two pairs of head set terminals. Quick easy connections. Polished round barrel. Fits any standard jack.

ENCLOSED DETECTOR



One of the finest crystal detectors on the market. Supersensitive galena crystal enclosed in heavy glass shield. Quick, positive adjustment. Brass parts polished nickel finish.

Z730 Each $1.18

GALENA DETECTOR

Easy fine adjustment. Crystal mounted in cup. Moulded base and knob. Brass parts polished nickel finish. An unequaled value.

Z732 Each 50c

DETECTOR CRYSTALS CAREFULLY TESTED

Z736 Galena, Arlington tested, per piece.10c
Z738 Silicon, Arlington tested, per piece.10c
Z735 Tested, Galena, per piece..... 8c
Z737 Tested, Silicon, per piece 8c

DETECTOR PARTS

Z725 Price set...32c

All metal parts for crystal detector. No base included. Easily assembled. Polished nickel finish.

BAKELITE DIAL AND KNOB

Moulded of genuine bakelite, polished black finish. Fluted knob. Fine engraved scale with sharp clear graduations and figures in contrasting white enamel. This is the finest quality dial and knob in very attractive pattern. Two inch cannot be supplied for ¼ inch shaft.

.915 2 in. Diam. for 3-16 in. shaft. Ea...30c
.902 3 in. Diam. for 3-16 in. shaft. Ea...30c
Z903 3 in. Diam. for ¼ in. shaft. Ea....35c
Z916 4 in. Diam. for ¼ in. shaft. Ea....45c

ONE-PIECE DIAL AND KNOB

Moulded in one piece of polished black composition with clean plain engraved scale and numerals in contrasting white enamel. Ribbed knob to fit the hand. An attractive neat pattern.

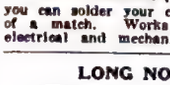
Z900 2¼ in. Diam. for 3-16 in. shaft. Ea. 19c
Z901 2¼ in. Diam. for ¼ in. shaft. Ea..19c
Z904 3 in. Diam. for 3-16 in. shaft. Ea...25c
Z905 3 in. Diam. for ¼ in. shaft. Ea....25c
Z906 4 in. Diam. for 3-16 in. shaft. Ea...35c
Z907 4 in. Diam. for ¼ in. shaft. Ea.....35c

ROSIN CORE SOLDER

Z958 Per coil 22c

Self fluxing. Especially designed for soldering electrical connections. Fine for use with above electric iron. Coil will last a long time.

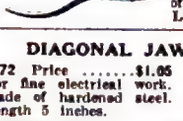
TINOL



Z959 Per tube 19c

With this preparation you can solder your connection with the heat of a match. Works fast. Makes a perfect electrical and mechanical joint. Self fluxing.

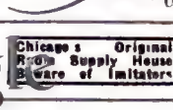
LONG NOSE PLIERS



Z970 Price ...$1.10

The handiest pliers for radio work. Made of fine hardened steel. Length 5 inches.

DIAGONAL JAW NIPPERS



Z972 Price $1.05

For fine electrical work. Made of hardened steel. Length 5 inches.

RADIO JACKS AND PLUGS

Finest grade jacks. Improved design. Best materials. Phosphor bronze springs. Silver contact points. Nickel finish. Mount on panels ⅛ to ⅜ in. thick.

Jacks Only
Z390 Open circuit. Each.....43c
Z391 Closed circuit. Each.....49c
Z392 Two circuit. Each 60c
Z393 Single circuit filament cont. 69c
Z394 Two circuit filament cont...85c
Z395 Plug. Large space with set screws for attaching cord. Each.....49c

COMPETITOR JACK AND PLUG

Well made, durable, smooth working. Interchangeable with any standard Jacks and Plugs Solder connections. Nickel finished metal parts.

Z387 Open circuit jack. Each.....27c
Z388 Two circuit jack. Each 35c
Z389 Standard plug. Each 35c

BINDING POSTS

Brass, polished nickel finish. Washer and 6-32 in. screw extending ⅝ in.

Z370 Large size—barel and knob ¾ in. long, dozen..85c
Z372 Smaller size — barrel and knob 9-16 in. long, dozen. 70c
Z374 Large size with composition knob, dozen.....50c
Z376 Large size with hole for phone tip or wire, dozen.....80c
Z378 Small size with hole for phone tip or wire, dozen 35c

SWITCH CONTACT POINTS

Brass polished nickel finish. All have ⅝ in. long size 6-32 screws and two nuts. All prices the same.

Dozen 18c Hundred $1.05

Order by Article Number.

Z360 Head, ¼ in.; Diam. ¼ in. High
Z362 Head, 3-16 in.; Diam. ⅜ in. High
Z363 Head, 3-16 in.; Diam. 1-16 in. High

Solder Lugs to Fit Contact Points

Also for connecting wires to binding posts, etc.

Z365 Dozen 12c — Hundred 80c

SWITCH LEVERS

Moulded composition knob. Exposed metal parts polished nickel finish. Fitted with panel bushing, spring and two set nuts. A high grade switch.

Z382 1½ in. Radius
Z381 1¼ in. Radius
Z380 1 in. Radius
} 18c Each

SWITCH LEVER STOP

Brass, polished nickel finish.

Z386—Dozen 18c. Hundred $1.05

INDUCTANCE SWITCH, INCLUDING KNOB AND DIAL

Mounts switch point and contact lever behind panel. Enables you to build neat attractive set. Only one hole needed to mount on panel. 15 switch points, any number of which may be used. Dial indicates position of lever. Smooth wiping contacts. Attractive tapered knob.

Z285 Price including knob and dial....$1.80

OUTDOOR LIGHTNING ARRESTER

Z980 Price $1.68

Protect your instruments with this lightning arrester. You cannot afford not to. Weatherproof porcelain case. Air gap type. Permanent. Durable. The most practical quality arrester obtainable. Underwriters approved.

CABINETS

Fine looking cabinets solidly built. Made of genuine solid mahogany in elegant hand rubbed finish. You will be proud of your set mounted in one of these cabinets. Hinged tops. Front Panels not included. rabbeted to take panels. Prices are transportation paid.

Panel Size	Inside Dimensions High	Wide	Deep	Art. No.	Price Each
6x 7"	5 ⅛"	6 ⅛"	7"	Z420	$2.48
6x10 ⅛"	5 ⅛"	10 "	7"	Z422	2.75
6x14"	5 ⅛"	13 ⅛"	7"	Z424	3.30
7x14"	6 ⅛"	13 ⅛"	7"	Z423	3.60
7x18"	6 ⅛"	17 ⅛"	7"	Z426	3.90
7x21"	6 ⅛"	20 ⅛"	7"	Z425	4.20
9x14"	8 ⅛"	13 ⅛"	10"	Z428	3.70
12x14"	11 ⅛"	13 ⅛"	10"	Z430	4.40
12x21"	11 ⅛"	20 ⅛"	10"	Z432	5.25

RADIO "BAKELITE" PANELS

Notice our very low prices on this fine quality material. We supply genuine Bakelite, Condensite, Celeron or Formica, all of which are materials with practically identical mechanical, chemical and electrical properties. Machines well without chipping. Won't warp. Waterproof. Highest mechanical and dielectric strength. Attractive natural polished black finish which can be sanded and oiled for extra fine work.

Panel Size Inches	⅛" thick Art No.	Price	3-16" thick Art No.	Price	¼" thick Art No.	Price
6x7	Z450	$0.50	Z460	$0.75	Z470	$0.98
6x10 ½	Z451	.75	Z461	1.11	Z470	1.47
6x14	Z452	1.05	Z462	1.55	Z472	2.05
7x14	Z458	1.20	Z488	1.80	Z478	2.40
7x18	Z453	1.55	Z463	2.30	Z473	3.10
7x21	Z457	1.78	Z467	2.65	Z477	3.60
9x14	Z454	1.60	Z464	2.35	Z474	3.10
12x14	Z455	2.10	Z465	3.15	Z475	4.15
12x21	Z456	3.15	Z466	4.65	Z476	6.20

ETCHED METAL NAME PLATES

Made of brass. Silver plated characters and border on black background. All plates are 1 inch long and ⅜ inch wide, except "INCREASE CURRENT" which are quarter circle 1⅜ inch over all, and "ON" "OFF" which are ⅝ inch long. Attaching holes pierced.

Z503 Per Dozen 35c

Not less than one dozen assorted sold. Specify marking wanted as follows:

Plate Variometer	Secondary	Aerial
Grid Variometer	Primary	Ground
Vacuum	Tickler	Phones
Primary Condenser	Lead'g Coil	Input
Secondary Condenser	Coupling	Output
Increase Current (to right)	Parallel	On
	Series	Off
Increase Current (to left)	Detector	1st Step
	A Battery	2nd Step
	B Battery	3rd Step

(Blank—takes pencil or pen marks)

ELECTRIC SOLDERING IRON

Z957 Price $5.75

Especially adapted to radio work. Will enable you to do neat clean work quickly. Simply attach to any light socket 110-120 volts. Complete with six foot cord and attaching plug. Renewable solder point. Will last a lifetime for ordinary home or light shop work. A wonderful value at the price.

MAGNET WIRE

Insulated copper wire. Best quality even drawn wire, one piece to a spool. Prices quoted are for 8 oz. spools.

Double Cotton Covered Number Z990		Enameled Insulation Number Z992		Green Silk Covered Number Z991	
Gauge	Price	Gauge	Price	Gauge	Price
18	.50c	20	.45c	20	$0.78
20	.60c	22	.55c	22	.90
22	.75c	24	.65c	24	1.05
24	.85c	26	.85c	26	1.18
26	.95c	30	.70c	30	1.70
28	$1.15	32	.75c	32	2.05
30	1.65	36	.95c	36	2.75

STRANDED ANTENNA WIRE

Cabled of fine copper strands. Very flexible High tensile strength. Best for aerials.

Z248—100 ft. coil 72c Z249—500 ft. coil $3.20

SPAGHETTI

For covering connecting wires in sets. For size 12 and 14 wires.

Z955—Finest quality braided and saturated with best baked lustrous transparent insulating varnish, 3 feet for 20c
Z956 Best quality braid and covered with black insulating compound. 3 feet for.....15c

ANTENNA INSULATORS

Z260 Size 1x3½.
Two for 17c
Z262 Size 2½x3¼.
Two for 58c
Z284 Size 1½x4.
Two for 80c
Z266 Size 1½x10½.
Two for $1.35

P250 P252 P254-A

SOLID BARE COPPER WIRE

Solid bare copper wire for aerials, leads or wiring instruments.

Solid Bare Copper Wire, size 14
Z240—100 ft. coil 45c Z242—500 ft. coil $2.15

Solid Bare Copper Wire, size 12
Z244—100 ft. coil 61c Z245—500 ft. coil $2.75

THE BARAWIK CO. Chicago's Original Radio Supply House Aware of Imitators **102 South Canal Street** **CHICAGO, ILL.**

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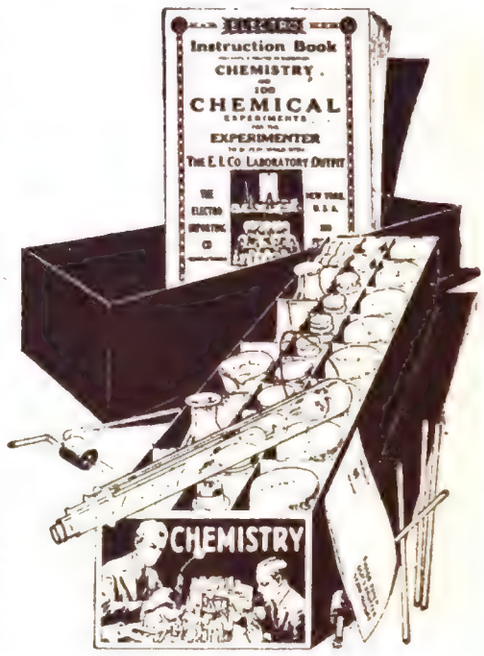
A Chemistry Laboratory for $7.00

Think of it, fellows! Here is a real chemistry outfit with regular chemical apparatus that performs those fascinating, actual chemical experiments.

This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive amusing experiments.



DESCRIPTION OF THE OUTFIT

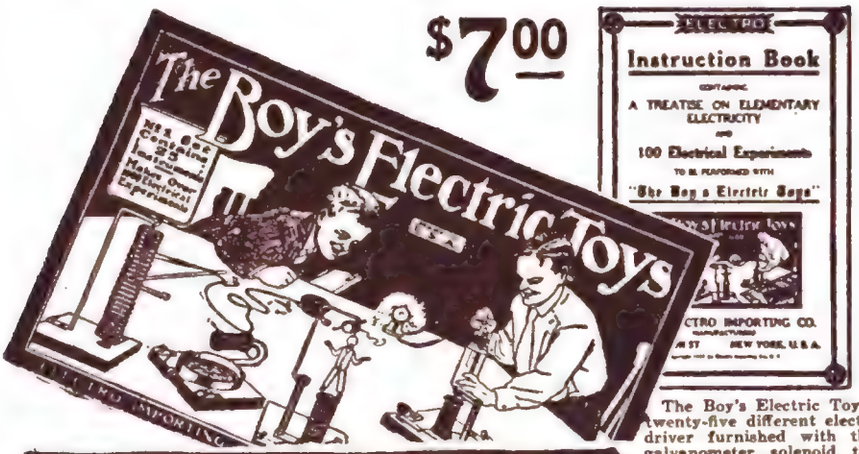
The outfit consists of forty-four (44) chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers, and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. 17 pieces of apparata furnished with this outfit.

The instruction book is a real Chemistry Course for the Beginner. Some of the Contents are: Division of Matter: This is a Treatise on Elementary Chemistry, and deals with the theory of the Elements, Molecules and Atoms, etc.

100 EXPERIMENTS

How to make chemical tricks; how to make invisible and magic inks; how to test flour; how to test soil; how to make chlorine gas and smoke (German War Gas); how to bleach cloth and flowers; how to produce oxygen and hydrogen; how to make chemical colors; how to test acids and alkalies, and hundreds of interesting hints and formulas.



$7.00

Every Fellow Wants the BOY'S ELECTRIC TOYS

The Boy's Electric Toy contains: Enough material to make and complete over twenty-five different electrical apparatus without any other tools except a screwdriver furnished with the outfit. Student's chromic plunge battery, compass-galvanometer, solenoid, telephone receiver, electric lamp. Enough various parts, wire, etc., are furnished to make the following apparatus:

Electromagnet, electric cannon, magnetic pictures, dancing spiral, electric hammer, galvanometer, voltmeter, hook for telephone receiver, condenser, sensitive microphone, short distance wireless telephone, test storage battery, shocking coil, complete telegraph set, electric riveting machine, electric buzzer, dancing fishes, singing telephones, mysterious dancing man, electric jumping jack, magnetic geometric figures, rheostat erratic pendulum, electric butterfly, thermo electric motor, visual telegraph, etc., etc.,

This does not by any means exhaust the list, but a great many more apparatus can be built actually and effectually.

With the instruction book we furnish one hundred experiments that can be made with this outfit, nearly all of these being illustrated with superb illustrations. No other materials, goods or supplies are necessary to perform any of the one hundred experiments or to make any of the 25 apparatus. Everything can be constructed and accomplished by the means of this outfit, two hands and a screwdriver.

The outfit contains 114 separate pieces of material and 24 pieces of finished articles ready to use at once.

We guarantee satisfaction.

The size over all the outfit is 14 x 9 x 2¾. Shipping weight, 8 pounds. "The Boy's Electric Toys" outfit as described, $7.00. Immediate shipment.

SEND FOR YOUR SET TODAY

REMEMBER

JUST CLIP THE COUPON—DON'T SEND MONEY

ELECTRO IMPORTING CO., 233 Fulton St., New York City

ELECTRO IMPORTING CO.,
233 Fulton St., New York.

Please send me by express THE CHEMICAL LABORATORY. If I don't like it I need not accept it. If I want it I only pay $7.00 plus the few cents express charge.

.....

.....

S. & I. 4-23

ELECTRO IMPORTING CO.,
233 Fulton St., New York.

Please send me by express THE BOY'S ELECTRIC TOYS. If I don't like it I need not accept it. If I want it I only pay $7.00 plus the few cents express charge.

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S. & I. 4-23

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The Belin Radio-Television Scheme

By ROBERT E. LACAULT

(*Continued from page* 1166)

one hole of the disc at a time but the speed of the disc exceeded ten revolutions per second, making it impossible for the eye to perceive the interruptions.

On account of the spiral shape of the row of holes, each ray of light strikes on the screen, 3, a different grade of gray which, therefore, increases the light from zero to its full value at every turn of the disc. The rays are concentrated through another lens upon a very sensitive photo-electric cell connected through an amplifier to a radiophone transmitter of the usual type. The variations of light acting upon the photo-electric cell modulate the current of the radiophone in the same manner as if a microphone were connected to the input side in place of the photo-electric cell.

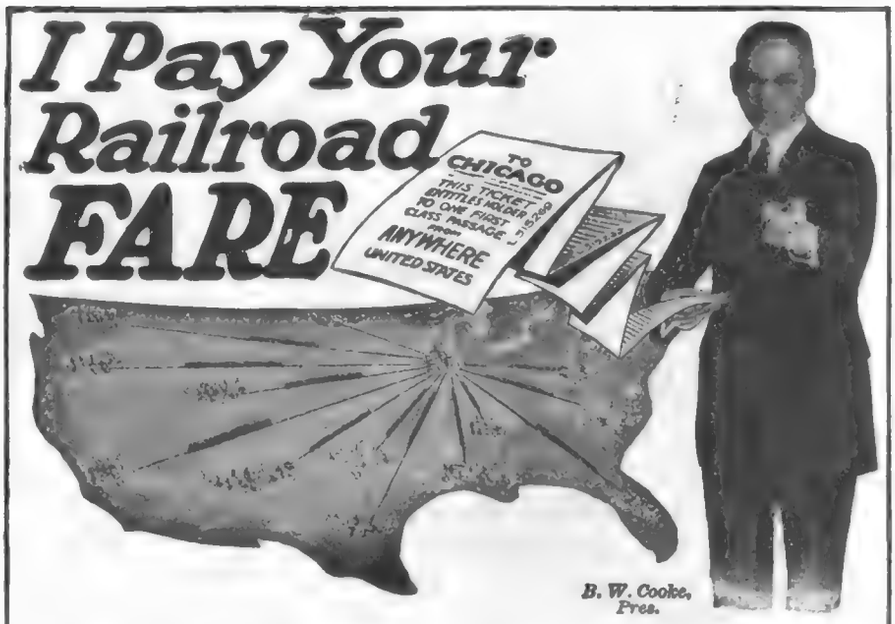
Radio waves were emitted from the radiophone set, modulated to the contour of those shown in Fig. 3; since the variations produced were identical at every turn of the disc. The increase from nothing when no light was impressed upon the cell, to maximum value when the light passed through the white part of the screen, produced in the photo-electric cell a progressive variation. At the receiving end, a loop antenna connected to a tuner and amplifier collected the waves and transformed them into audio frequency variations of the same shape as that of the modulated waves. The output current from the amplifier was passed through the movable coil of an oscillograph, this coil being composed of a loop of silver wire, one-thousandth of an inch thick, supporting a small mirror about $\frac{1}{32}$ of an inch square.

Since this movable coil is acted upon by a strong magnetic field, it tends to turn whenever a current passes through the wire, the deflection being proportional to the intensity of the current. This variation causes the tiny mirror upon which a powerful beam of light is concentrated to produce a deflection of the beam which is reflected upon a screen similar to the one used at the transmitter. Behind this screen is placed another lens projecting upon a white screen, the light received which is reproduced in the shape of a luminous strip varying in color from black to white and representing an example of what may be accomplished with this type of apparatus.

Another experiment carried out during the lecture was the transmission of a little black square moved by hand in front of the screen. At the receiving apparatus, the audience could see on the screen the little square moving at the same speed as it was displaced in front of the transmitting screen.

The photo-electric cell used in these experiments is of a new type recently invented, having a grid made of fine platinum wires and a cathode made of an alkali metal. (See Fig. 4.) When a luminous ray strikes the cathode, electrons are emitted changing considerably the electric resistance between the electrodes. This system is of a very great sensitiveness and is absolutely instantaneous in action, modifying an electric current at any desired speed when a light is varied in intensity in front of the cell.

In another system which Mr. Belin uses in his laboratories, moving pictures may be displaced rapidly in front fo the transmitting apparatus. Each picture of the film may be resolved into about 10,000 points, being explored over all its surface at such a speed that every part of the picture is reproduced at the receiver exactly as it is and with all the accuracy necessary to give perfect reproduction upon a screen when the picture is enlarged.


I Pay Your Railroad FARE
TO CHICAGO
THIS TICKET ENTITLES HOLDER TO ONE FIRST CLASS PASSAGE FROM
ANYWHERE
UNITED STATES
B. W. Cooke, Pres.

COME TO CHICAGO—the Electrical Center of the World—I pay your railroad fare from any place in the United States. Grasp this opportunity to see the country at my expense. Don't stick in one spot—travel—get experience. Come to Coyne—the largest school in the country that specializes in practical electrical instruction *only*.

Learn Electricity In 3 Months

Get a complete training so you can make big money as Power Plant Operator, Superintendent, Telephone man, Construction worker, auto, truck or tractor electrician, battery man, radio expert, or you can go into business for yourself as electrical contractor, dealer, auto ignition or battery expert and make from $3,000 to $20,000 a year. Hundreds of our graduates today are making big money and you can do the same if you grasp this opportunity—act now.

Coyne INDORSED BY ELECTRICAL INDUSTRY

No books or useless theory. You are trained on $100,000 worth of electrical equipment. Everything from door bells to power plants. You work on motors, generators, house-wiring, autos, batteries, radio, switch-boards, power plants—everything to make you an expert ready to step right into a position paying from $45 to $100 a week.

Radio Course Free. We include the following free with the regular course:
(1) A complete course in auto, truck and tractor electricity and storage batteries. Greatest outlay of auto, electrical and battery equipment in the country.
(2) Course in Radio—the marvel of the age. Constructing, installing and operating. Build your own wireless telephone set.
(3) Life membership in the Coyne school. Stay as long as you wish and return for further training at any time in the future.

Earn While You Learn! We help students to secure jobs to earn a good part of their expenses while studying.

Student winding a Stator

SEND COUPON

Don't delay a minute; send that coupon *right now* for our big free catalog and full particulars of Free Railroad Fare offer. Remember this special offer is limited so act now.

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B. W. Cooke, Pres.
Coyne Trade and Engineering School
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Dear Sir: Please send me free your big catalog and full particulars of your special offer of Free Railroad Fare and two extra courses.

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Address .....

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TYPEWRITER SENSATION

Free Trial—Use as You Pay

After trial send us only $5.00 a month until the low total price of $58.50 is paid, and the machine is yours. This is absolutely the most generous typewriter offer we ever made. Do not rent a machine when you can pay $5.00 a month and own one. Think of it—Buying a $100.00 Machine for $58.50. Cash price $53.00, just a little more than half its original price.

SELF-STARTING NO. Remington 10

Perfect machines, Correspondence size, Keyboard of Standard Universal arrangement, 42 Keys, writing 84 characters. The entire line of writing completely visible at all times, has the tabulator, the two color ribbon, with automatic reverse, the back spacer, variable spacer, self-starter, in fact, every late style feature and modern operating convenience. Comes to you with everything complete; tools, cover, operating book and instructions — nothing extra to buy.

You cannot imagine the perfection of this beautiful reconstructed typewriter until you have seen it. We have sold thousands of these perfect late style machines at this bargain price and every one of these thousands of satisfied customers had this beautiful, strictly up-to-date machine on five days' free trial before deciding to buy it.

We will send it to you F.O.B. Chicago for five days' free trial. It will sell itself, but if you are not satisfied that this is the greatest typewriter you ever saw, you can return it at our expense. You won't want to return it after you try it, for we are sure you cannot equal this wonderful value anywhere.

Send No Money $4.50 After Trial

Put in Your Order *Now*

When the typewriter arrives deposit with the express agent $4.50 and take the machine for five days' trial. If you are convinced that it is the best typewriter you ever saw keep it and send us $5.00 a month until our bargain price of $58.50 is paid. If you don't want it, return it to the express agent, receive your $4.50 and return the machine. We will pay the return express charges. This machine is guaranteed just as if you paid $100.00 for it. It is standard. Over half a million people own and use these typewriters and think them the best ever manufactured. **The supply at this price is limited, the price will probably be raised when next advertisement appears, so don't delay. Fill in the coupon today — the typewriter will be shipped promptly.** There is no red tape. We employ no solicitors—no collectors—no chattel mortgage. It is simply understood that we retain title to the machine until full $58.50 is paid. You cannot lose. You will perhaps never have a greater typewriter opportunity. **Do not send us one cent. Get the coupon in the mails to-day—sure.**

Young Typewriter Co., Dept. 184, 25 W. Lake St. **Chicago**

Young Typewriter Co., Department 184, 25 W. Lake St. **Chicago**

Ship me the Remington No. 10 Typewriter, F. O. B. Chicago, as described in this advertisement. I will pay you $5.00 monthly as rent until the $54.00 balance of the SPECIAL $58.50 sale price is paid. The title to remain in you until fully paid for. It is understood that I have five days in which to examine and try the typewriter. If I choose not to keep it I will carefully repack it and return it to the express agent. It is understood that you give the standard guarantee.

Name.....

Street Address.....

City.....*State*.....

Business or Occupation.....

5 Master Keys

Work like magic in emergencies or prove whether your door or padlocks are burglar-proof. Open and test thousands of different locks. Most wonderful and only of its kind. Send $1 today. Novel FREE with set.

Y CO., 8-R Manhattan Block, Milwaukee, Wis.

Answers to Problems on Page 1180.

A NEW HEATING SYSTEM

Theoretically the plan is perfectly possible, but the practical difficulties are seen to be insurmountable as soon as one figures out just what pressure would be required. When a pound of water is poured from a height of one foot into a pan, the potential energy of the water (in this case one foot pound) is converted into an equivalent amount of heat energy. If the pound of water were poured from a height of 778 feet, the energy converted into heat would be 778 foot-pounds and the pound of water would rise one degree Fahrenheit in temperature, provided it lost none of its heat during the fall. Now if we suppose that during the winter the water might be down to 32 degrees, it would be necessary to raise its temperature 180 degrees to bring it to the boiling point. Assuming that no heat were lost, a pound of ice water would have to drop 180×778 or 140,040 feet to accomplish this. Which means that the pressure developed at the power house would have to be equal to the pressure at the bottom of a tank of water 26.5 miles deep—or a pressure of somewhat over 8.7 million pounds per square foot!

HOW TO BREAK A BOTTLE

Taking the neck of the bottle between the middle and fore finger of the left hand, he quickly pressed in the cork with the thumb of his right. The pressure thus applied to the confined water is transmitted to the entire interior surface, and the resulting total pressure may be enormous.

THE HOLE IN THE ICE CREAM FREEZER

The people who make the mistake of cutting a hole near the bottom of their freezer have the erroneous notion that the water that surrounds the can does not aid in freezing the cream. But this is very far from true. The salt which is added to the ice causes it to melt and absorb heat from its surroundings. This results in a lowering of temperature and the water in turn cools the container which it surrounds. If the water were continually removed from the freezer, not only would there be considerable loss of the cooling material but the amount of the freezing mixture in contact with the sides of the container would be reduced and the cream would freeze more slowly.

THE PROBLEM OF THE BULLET

Let us suppose that A is in the front end of the car and B at the rear. Then B would ride towards A's bullet at the rate of 60 miles an hour while A would ride away from B's bullet at the same rate. However, B's bullet travels faster than it ordinarily would, for it has the velocity of the train added to its natural velocity, while A's bullet is retarded by the same amount, all speeds being taken relative to the earth. But relative to the train both bullets would travel at the same rate and hence we would expect the men would be hit simultaneously.

MOVEMENT ON A FRICTIONLESS SURFACE

Any attempt to walk on a perfectly frictionless surface would of course be impossible, for one's feet would slip back just as fast as he attempted to put them forward. By making swimming movements with his hands he could literally swim over the surface of the floor, or if he had something to throw in the opposite direction from that in which he wanted to proceed he might be able to get where he wanted to.

PERPETUAL MOTION

The perpetual motion device here shown would not work in spite of the difference in quantity of water in the tank and return pipe because the *pressure* per unit area at the bottom of each would be the same. By pressure we mean force per unit area, which is dependent upon the depth and density of the liquid and not upon the shape or size of the containing vessel.

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Production of High Vacua in the Laboratory

By RAYMOND B. WAILES

(*Continued from page* 1183)

The Macleod pump is shown in figure 3. The mercury is poured into R, whence it passes into N, and if R is higher than point L, and there is sufficient mercury, it will pass up the full length of N, over the bend and down M into the receptacle B. In falling the length of M, a Tonicellian vacuum is created at the top, which causes air to be drawn from branch V, which is connected to the tube to be exhausted. V should be at an angle and higher than the bend L, so that falling mercury will not enter the tube under exhaustion.

The mercury used in vacuum pumps should be bought as pure as possible. *Redistilled* mercury is adaptable, but should be purified before use in the pump by using the simple apparatus shown in figure 4. Here, an ordinary burette is partly filled with 8 per cent. nitric acid (8 cc. of strong nitric acid and 92 cc. of water).

The acid forms soluble compounds with the impurities of the mercury (usually present as oxides). The mercury should be well washed with water and dried by means of blotting paper laid over the surface.

In making small tubes for Geissler tubes, spectrum tubes, etc., electrodes are necessary. The best electrode material which can be used is platinum wire. Platinum wire of about 22 B. and S. gauge is not expensive for this purpose. In sealing in, the glass tube should be heated at the desired spot with a pointed flame and the softened spot touched with a tube of warmed glass. They will stick together, when they should at once be drawn apart, forming a projection. Break off this projection when it has cooled *slightly*, and insert the platinum electrode, already bent. Holding the platinum electrode with tweezers, fuse the glass projection back in place, imbedding the loop of the electrode in the glass as shown at B, figure 5.

If rubber tubing is used on vacuum pumps it should be filled with short lengths of glass tubing as shown in figure 5.

A simple external tin-foil electrode is shown in figure 6A.

Using a suction flask as shown in figure 6B, mercury can be easily purified of base metals. Air is sucked in by means of a water jet pump to be described in Part II.

(*To be concluded*)

Practical Chemical Experiments

By RAYMOND B. WAILES

(*Continued from page* 1179)

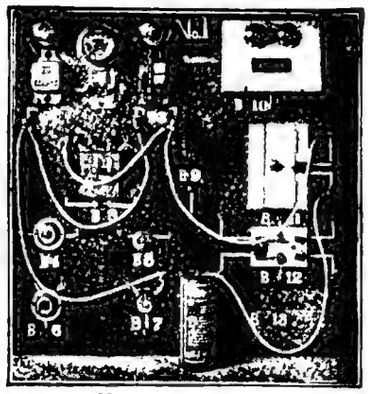
air from outside of the burner which enters through the adjustable port or air holes which can plainly be seen on the kitchen range. The air mixes with the gas and causes combustion at the burner disc.

If the air holes be closed by loosening the screw bolt and turning the disc, the flame will be seen to become yellow.

If a match is pierced near the head, by a pin and the pin used as a support for the match on a Bunsen burner as shown in Fig. 5, it will be found that the match will not take fire when the burner is lighted and is burning the blue flame.

The hottest part of the flame is a trifle above the tip of the inner cone of the flame.

The previous experiment can be more beautifully demonstrated by using a funnel fitted with a wire gauze as Fig. 6 shows. Gas is passed through the funnel and burns above the wire.



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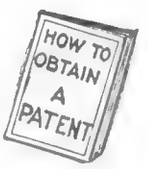

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Safety Tipping Lock

(700) Chas. H. Bradshaw, Trail, B. C., has designed a safety catch for "V" bottom smelter cars, which will prevent them from tipping while the molten metal is being carried to moulds. He asks whether the firm where he is employed has a right to the invention.

A. This depends on your employment contract. Usually, unless you are employed with the firm in the capacity of a consulting engineer, the concern has no right to your patent or idea, if the same was developed in your own time. If the work you are doing is associated directly with the designing of apparatus for that concern, then the company can claim the right to your patent. However, even though your device is of considerable value, we doubt if it will find a successful market, as the field is so limited and the expense of the device considerable. A legal battle, which will cause legislatures to pass a law compelling smelter companies to place these safety devices on their cars, is your only hope.

Capital Required

(701) P. A. Broadwood, Eastbourne, England, asks where he can secure American capital to develop a perpetual motion machine.

A. In view of the fact that the American public has been so often defrauded by supposed perpetual motion machines, there is very little chance of securing American financial capital in a venture of this nature. Right here in New Jersey an inventor has built up a large alleged perpetual motion machine; photos of which appeared recently in this publication. He was selling shares of stock in this corporation at a rate of ten cents per share, and he found it very difficult to secure enough capital to exist. It is a very simple matter to place two objects on opposite ends of an arm, and cause one end of the arm to swing downward and the other to rise upward. It is difficult to shift them from this position into another position, which will cause the arm to swing in the opposite direction. For instance, a steel ball and a wooden ball could be placed at the extreme ends of a beam, causing this beam to tip. The reversal is impossible without exerting outside force. Inasmuch as we do not believe that you can successfully build a working model of a perpetual motion machine, (which by the way should require practically no capital at all to construct), you will find it difficult to secure financial assistance, with only plans and blueprints to show.

Radio Loud-Talker

(702) C. M. Bontrager, Hoisington, Kansas, has submitted a design for a loud-talking device, which has an extension on the diaphragm of a telephone receiver. The needle of the phonographic reproducer is secured to this extension. He asks our opinion.

A. Due to the fact that microphonic amplifiers do not operate very well, creating a constant crackling sound, we believe that your device could not be employed efficiently on vacuum tube sets. We would suggest that you build an outfit using a loud-talking receiver arranged in a manner similar to your lay-out, and determine whether or not this receiver will cause amplification through the phonographic reproducer, tone arm and sound chamber. If such is the case and you find your way clear toward patenting the device, we would suggest that you secure a patent upon the same. Particularly would this be valuable if the instrument were made so that it could be attached to any type of telephone receiver.

Trolley Pole Guard

(703) M. V. Brown, Guthrie, Okla., asks whether a device to prevent a trolley pole from jumping off the wire, would be of value.

A. There are quite a number of devices of the nature of the one of which you speak, which are on the market at the present time, and which work very well. Scarcely any of these are being employed, and we doubt very much if your device will be of any greater value than those already patented. Inasmuch as you have not given us any specifications, we would qualify this latter statement slightly because we did not see drawings of your suggestion.

Whistling Toy Diabolo

(704) L. L. Blecher, Akron, Ohio, has designed a whistling Diabolo, and asks whether he should patent the same.

A. We doubt very much if you can patent your Toy Diabolo, inasmuch as the many forms of these have already been covered by patents. The writer remembers using one some years ago which had a number of holes cut in the side, so that the toy made a screeching noise as it sailed into the air. The time of these toys is passed, and we doubt if you could introduce them into the market again in this country, unless you are in a position to finance or manufacture the devices yourself. We would not suggest any action on a toy of this nature.

Developing a Patent

(705) A. C. Baurelie, Philadelphia, Pa., says that he has invented and patented a safety razor with four sided blades. He asks whether the suggestion is valuable and also how he should go about developing the idea.

A. If the razor which you have designed is so arranged that the corners of the blades do not cut into the skin, in other words, if these corners are rounded off, and if you can secure a manufacturer who would be willing to exploit the idea, we believe that a reasonably safe market can be developed. There are a great many safety razors on the market at the present time. Most of these have a double-sided blade, others have but a single-sided blade. In order to make a blade with four sides, the holder must be so arranged, that there shall be no possibility of cutting the face by drawing the corner of the edge of the razor across it. Placing this upon the market will depend largely upon your own initiative ability, and you should take every step in forcing the issue now that you have patented the device. First take the proposition up with the leading safety razor manufacturers. Offer them the razor at a very low cash price with additional royalties. Bind them to a contract, whereby they will guarantee to turn out a certain quantity of these razors every year. Insure the contract so that you shall not be the loser. If you find that this procedure is impossible, try to get in touch with leading novelty manufacturers, or place the device in the hands of some promotion concern.

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Thief Detector for Autos

(706) Walter Buck, Murphysboro, Ill., sends a drawing of a thief detector for automobiles, which consists of a switch connected with the horn operated by the choke. The switch locks when the choke is pulled. He states that every owner of a car should recognize his own horn.

A. From a commercial standpoint, your device has no value, as it is a simple matter to disconnect your thief-proof device. This type of thief detector is the one most easily overcome, and presents no obstruction to anyone trying to make away with the machine.

Making Rain with Electrified Sand

(*Continued from page* 1154)

light and mobile, compared with even the smallest dust particle, they are little acted upon by gravity. An ion, therefore, can do little toward coalescing drops already formed and dragging them to the earth, but ions do form very efficient nuclei for the initiation of condensation. Hence, charged ions may be spread in a moisture-saturated atmosphere, to cause condensation, and afterward charged dust may be spread, as hereinbefore described, to coalesce and precipitate the clouds thus formed.

"Ions may be scattered from an airplane by the use of any suitable ionizing means, such as X-rays. Another method is to trail from the plane a multitude of antennae or wires insulated from the plane and connected to one terminal of a undirectional, high potential electrical device. The other terminal of the high voltage device is connected to the frame of the airplane. Dispersing needles are provided on the upper wing of the machine or other suitable means to dissipate the charge, which tends to accumulate on the airplane. Such an arrangement spreads a cloud of ions of one sign below the plane, and a cloud of ions of the opposite sign in the strata above the plane. The two clouds of ions should be far enough separated, so that the ions do not recombine before condensation begins. After condensation begins, the mutual attraction of the oppositely charged drops in the two strata, cause them to coalesce and aid precipitation. For the effective operation of the method described above, the potential of the electrical device should be sufficient to produce the familiar brush or glow discharge from the ends of the antennae wires.

"Clouds of smoke, dust and the like, and clouds or vapors of materials other than water, may also be treated and precipitated by use of the foregoing processes."

Recently an announcement was made by Mr. Arthur Brisbane, famous American journalist connected with the Hearst publications, that he has had a plan in mind for many years for the production of rain. Mr. Brisbane's scheme is to use aircraft of sufficiently large size, possibly dirigibles, and to load aboard these aircraft many tons of some thoroughly hydrophilous substance, such as ordinary lime, which farmers scatter over their fields. The next step would be, according to his ideas, to fly above the clouds and scatter this very finely powdered lime over the clouds to act as dust nuclei for the water particles to coalesce on. The propellers of the flying machines would help to scatter the dust over a wide path, and one of the principal features of Mr. Brisbane's idea is that the lime thus scattered in the upper atmosphere, would eventually precipitate along with the water vapor in the form of rain, and would result in the lime returning to the soil where it would do much good, mixed with the water as it would be.

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The Thing from Outside

By GEORGE ALLAN ENGLAND

(*Continued from page* 1163)

"This something, this Thing," continued Jandron, "is a Thing that can't be killed by bullets. It's what caught our guides on the barrens, as they ran away—poor fools!"

A shadow fell across the print in the rock. Mrs. Thorburn had come up, was standing there. She had overheard a little of what Jandron had been saying.

"Nonsense!" she tried to exclaim, but she was shivering so she could hardly speak.

THAT night, after a long afternoon of paddling and portaging—laboring against inhibitions like those in a nightmare—they camped on shelving rocks that slanted to the river.

"After all," said the Professor, when supper was done, "we mustn't get into a panic. I know extraordinary things are reported from the wilderness, and more than one man has come out, raving. But we, by Jove! with our superior brains—we aren't going to let Nature play us any tricks!"

"And of course," added his wife, her arm about Vivian, "everything in the universe *is* a natural force. There's really no supernatural, at all."

"Admitted," Jandron replied. "But how about things *outside* the universe?"

"And they call you a scientist!" gibed Marr; but the Professor leaned forward, his brows knit.

"Hm!" he grunted. A little silence fell.

"You don't mean, really," asked Vivian, "that you think there's life and intelligence—Outside?"

Jandron looked at the girl. Her beauty, haloed with ruddy gold from the firelight, was a pain to him as he answered:

"Yes, I do. And dangerous life, too. I know what I've seen, in the North Country. I know what I've seen!"

Silence again, save for the crepitation of the flames, the fall of an ember, the murmur of the current. Darkness narrowed the wilderness to just that circle of flickering light ringed by the forest and the river, brooded over by the pale stars.

"Of course you can't expect a scientific man to take you seriously," commented the Professor.

"I know what I've seen! I tell you there's Something entirely outside man's knowledge."

"Poor fellow!" scoffed the journalist; but even as he spoke his hand pressed his forehead.

"There are Things at work," Jandron affirmed, with dogged persistence. He lighted his pipe with a blazing twig. Its flame revealed his face drawn, lined. "Things. Things that reckon with us no more than we do with ants. Less, perhaps."

The flame of the twig died. Night stood closer, watching.

"Suppose there are?" the girl asked. "What's that got to do with these prints in the rock?"

"*They,*" answered Jandron, "are marks left by one of those Things. Footprints, maybe. That Thing is near us, here and now!"

Marr's laugh broke a long stillness.

"And you," he exclaimed, "with an A.M. and a B.S. to write after your name."

"If you knew more," retorted Jandron, "you'd know a devilish sight less. It's only ignorance that's cock-sure."

"But," dogmatized the Professor, "no scientist of any standing has ever admitted any outside interference with this planet."

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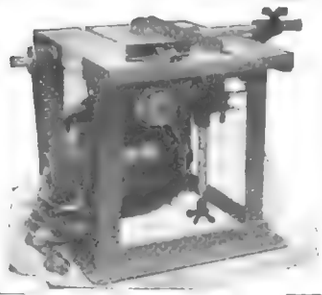

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"No, and for thousands of years nobody ever admitted that the world was round, either. What I've seen, I know."

"Well, what *have* you seen?" asked Mrs. Thorburn, shivering.

"You'll excuse me, please, for not going into that, just now."

"You mean," the Professor demanded, dryly, "if the —— hm! —— this supposititious Thing wants to ——?"

"It'll do any inferr .l thing it takes a fancy to, yes! If It happens to want us—"

"But what *could* Things like that want of us? Why should They come here, at all "

"Oh, for various things. For inanimate objects, at times, and then again for living beings. They've come here lots of times, I tell you," Jandron asserted with strange irritation, "and got what They wanted, and then gone away to—Somewhere. If one of Them happens to want us, for any reason, It will take us, that's all. If It doesn't want us, It will ignore us, as we'd ignore gorillas in Africa if we were looking for gold. But if it was gorilla-fur we wanted, that would be different for the gorillas, wouldn't it?"

"What in the world," asked Vivian, "could a—well, a Thing from Outside want of *us?*"

"What do men want, say, of guinea-pigs? Men experiment with 'em, of course. Superior beings use inferior, for their own ends. To assume that man is the supreme product of evolution is gross self-conceit. Might not some superior Thing want to experiment with human beings, what?"

"But how?" demanded Marr.

"The human brain is the most highly-organized form of matter known to this planet. Suppose, now—"

"Nonsense!" interrupted the Professor. "All hands to the sleeping-bags, and no more of this. I've got a wretched headache. Let's anchor in Blanket Bay!"

He, and both the women, turned in. Jandron and Marr sat a while longer by the fire. They kept plenty of wood piled on it, too, for an unnatural chill transfixed the night-air. The fire burned strangely blue, with greenish flicks of flame.

At length, after vast acerbities of disagreement, the geologist and the newspaperman sought their sleeping-bags. The fire was a comfort. Not that a fire could avail a pin's weight against a Thing from interstellar space, but subjectively it was a comfort. The instincts of a million years, centering around protection by fire, cannot be obliterated.

After a time—worn out by a day of nerve-strain and of battling with swift currents, of flight from Something invisible, intangible—they all slept.

The deeps of space, star-sprinkled, hung above them with vastness immeasurable, cold beyond all understanding of the human mind.

Jandron woke first, in a red dawn.

He blinked at the fire, as he crawled from his sleeping-bag. The fire was dead; and yet it had not burned out. Much wood remained unconsumed, charred over, as if some gigantic extinguisher had in the night been lowered over it.

"*Hmmm!*" growled Jandron. He glanced about him, on the ledge. "Prints, too. I might have known!"

He aroused Marr. Despite all the journalist's mocking hostility, Jandron felt more in common with this man of his own age than with the Professor, who was close on sixty.

"Look here, now!" said he. "*It* has been all around here. See? *It* put out our fire—maybe the fire annoyed It, some way—and *It* walked round us, everywhere." His gray eyes smouldered. "I guess, by gad, you've got to admit facts, now!"

The journalist could only shiver and stare.

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Original from UNIVERSITY OF CHICAGO

"Lord, what a head I've got on me, this morning!" he chattered. He rubbed his forehead with a shaking hand, and started for the river. Most of his assurance had vanished. He looked badly done up.

"Well, what say?" demanded Jandron. "See these fresh prints?"

"Damn the prints!" retorted Marr, and fell to grumbling some unintelligible thing. He washed unsteadily, and remained crouching at the river's lip, inert, numbed.

Jandron, despite a gnawing at the base of his brain, carefully examined the ledge. He found prints scattered everywhere, and some even on the river-bottom near the shore. Wherever water had collected in the prints on the rock, it had frozen hard. Each print in the river-bed, too, was white with ice. Ice that the rushing current could not melt.

"Well, by gad!" he exclaimed. He lighted his pipe and tried to think. Horribly afraid—yes, he felt horribly afraid, but determined. Presently, as a little power of concentration came back, he noticed that all the prints were in straight lines, each mark about two feet from the next.

"*It* was observing us while we slept," said Jandron.

"What nonsense are you talking, eh?" demanded Marr. His dark, heavy face sagged. "Fire, now, and grub!"

He got up and shuffled unsteadily away from the river. Then he stopped with a jerk, staring.

"Look! Look a' that axe!" he gulped, pointing.

Jandron picked up the axe, by the handle, taking good care not to touch the steel. The blade was white-furred with frost. And deep into it, punching out part of the edge, one of the prints was stamped.

"This metal," said he, "is clean gone. It's been absorbed. The Thing doesn't recognize any difference in materials. Water and steel and rock are all the same to It.

"You're crazy!" snarled the journalist. "How could a Thing travel on one leg, hopping along, making marks like that?"

"It could roll, if it was disk-shaped. And —"

A cry from the Professor turned them. Thorburn was stumbling toward them, hands out and tremulous.

"My wife—!" he choked.

Vivian was kneeling beside her sister, frightened, dazed.

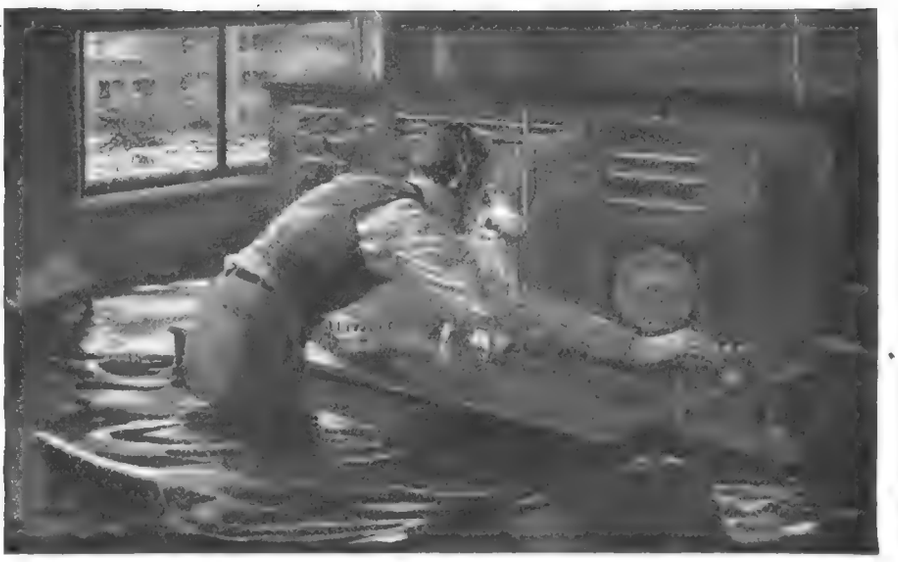
"Something's happened!" stammered the Professor. "Here— come here—!"

Mrs. Thorburn was beyond any power of theirs, to help. She was still breathing; but her respirations were stertorous, and a complete paralysis had stricken her. Her eyes, half-open and expressionless, showed pupils startlingly dilated. No resources of the party's drug-kit produced the slightest effect on the woman.

The next half-hour was a confused panic, breaking camp, getting Mrs. Thorburn into a canoe, and leaving that accursed place, with a furious energy of terror that could no longer reason. Up-stream, ever up against the swirl of the current the party fought, driven by horror. With no thought of food or drink, paying no heed to landmarks, lashed forward only by the mad desire to be gone, the three men and the girl flung every ounce of their energy into the paddles. Their panting breath mingled with the sound of swirling eddies. A mist-blurred sun brooded over the northern wilds. Unheeded, hosts of black-flies sang high-pitched keenings all about the fugitives. On either hand the forest waited, watched.

Only after two hours of sweating toil had brought exhaustion did they stop, in the shelter of a cove where black waters circled, foam-flecked. There they found the Professor's wife was dead.

Nothing remained to do but bury her. At first Thorburn would not hear of it. Like a madman he insisted that through all haz-



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ards he would fetch the body out. But no—impossible. So, after a terrible time, he yielded.

In spite of her grief, Vivian was admirable. She understood what must be done. It was her voice that said the prayers; her hand that—lacking flowers—laid the firboughs on the cairn. The Professor was dazed past doing anything, saying anything.

Toward mid-afternoon, the party landed again, many miles up-river. Necessity forced them to eat. Fire would not burn. Every time they lighted it, it smouldered and went out with a heavy, greasy smoke. The fugitives ate cold food and drank water, then shoved off in two canoes and once more fled.

In the third canoe, hauled to the edge of the forest, lay all the rock-specimens, data and curios, scientific instruments. The party kept only Marr's diary, a compass, supplies, fire-arms and medicine-kit.

"We can find the things we've left—sometime," said Jandron, noting the place well. "Sometime—after *It* has gone."

"And bring the body out," added Thorburn. Tears, for the first time, wet his eyes. Vivian said nothing. Marr tried to light his pipe. He seemed to forget that nothing, not even tobacco, would burn now.

VIVIAN and Jandron occupied one canoe The other carried the Professor and Marr. Thus the power of the two canoes was about the same. They kept well together, upstream.

The fugitives paddled and portaged with a dumb, desperate energy. Toward evening they struck into what they believed to be the Mamattawan. A mile up this, as the blurred sun faded beyond a wilderness of ominous silence, they camped. Here they made determined efforts to kindle fire. Not even alcohol from the drug-kit would start it. Cold, they mumbled a little food; cold, they huddled into their sleeping-bags, there to lie with darkness leaden on their fear. After a long time, up over a world void of all sound save the river-flow, slid an amber moon notched by the ragged tops of the conifers. Even the wail of a timber-wolf would have come as welcome relief; but no wolf howled.

Silence and night enfolded them. And everywhere they felt that *It* was watching.

Foolishly enough, as a man will do foolish things in a crisis, Jandron laid his revolver outside his sleeping-bag, in easy reach. His thought—blurred by a strange, drawing headache—was:

"If *It* touches Vivian, I'll shoot!"

He realized the complete absurdity of trying to shoot a visitant from interstellar space; from the Fourth Dimension, maybe. But Jandron's ideas seemed tangled. Nothing would come right. He lay there, absorbed in a kind of waking nightmare. Now and then, rising on an elbow, he hearkened; all in vain. Nothing so much as stirred.

His thought drifted to better days, when all had been health, sanity, optimism; when nothing except jealousy of Marr, as concerned Vivian, had troubled him. Days when the sizzle of the frying-pan over friendly coals had made friendly wilderness music; when the wind and the northern stars, the whirr of the reel, the whispering vortex of the paddle in clear water had all been things of joy. Yes, and when a certain happy moment had, through some word or look of the girl, seemed to promise his heart's desire. But now—

"Damn it, I'll save *her*, anyhow!" he swore with savage intensity, knowing all the while that what was to be, would be, immitigably. Do ants, by any waving of an[illegible], stay the down-crushing foot of man?

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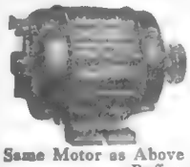

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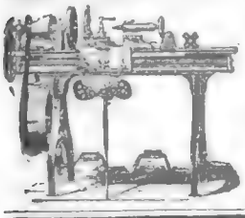

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NEXT morning, and the next, no sign of the Thing appeared. Hope revived that possibly It might have flitted away elsewhere; back, perhaps, to outer space. Many were the miles the urging paddles spurned behind. The fugitives calculated that a week more would bring them to the railroad. Fire burned again. Hot food and drink helped, wonderfully. But where were the fish?

"Most extraordinary," all at once said the Professor, at noonday camp. He had become quite rational again. "Do you realize, Jandron, we've seen no traces of life in some time?"

The geologist nodded. Only too clearly he had noted just that, but he had been keeping still about it.

"That's so, too!" chimed in Marr, enjoying the smoke that some incomprehensible turn of events was letting him have. "Not a muskrat or beaver. Not even a squirrel or bird."

"Not so much as a gnat or black-fly!" the Professor added. Jandron suddenly realized that he would have welcomed even those.

That afternoon, Marr fell into a suddenly vile temper. He mumbled curses against the guides, the current, the portages, everything. The Professor seemed more cheerful. Vivian complained of an oppressive headache. Jandron gave her the last of the aspirin tablets; and as he gave them, took her hand in his.

"I'll see *you* through, anyhow," said he. "I don't count, now. Nobody counts, only you!"

She gave him a long, silent look. He saw the sudden glint of tears in her eyes; felt the pressure of her hand, and knew they two had never been so near each other as in that moment under the shadow of the Unknown.

Next day—or it may have been two days later, for none of them could be quite sure about the passage of time—they came to a deserted lumber-camp. Even more than two days might have passed; because now their bacon was all gone, and only coffee, tobacco, beef-cubes and pilot-bread remained. The lack of fish and game had cut alarmingly into the duffle-bag. That day—whatever day it may have been—all four of them suffered terribly from headache of an odd, ring-shaped kind, as if something circular were being pressed down about their heads. The Professor said it was the sun that made his head ache. Vivian laid it to the wind and the gleam of the swift water, while Marr claimed it was the heat. Jandron wondered at all this, inasmuch as he plainly saw that the river had almost stopped flowing, and the day had become still and overcast.

They dragged their canoes upon a rotting stage of fir-poles and explored the lumber-camp; a mournful place set back in an old "slash," now partly overgrown with scrub poplar, maple and birch. The log buildings, covered with tar-paper partly torn from the pole roofs, were of the usual North Country type. Obviously the place had not been used for years. Even the landing-stage where once logs had been rolled into the stream had sagged to decay.

"I don't quite get the idea of this," Marr exclaimed. "Where did the logs go to? Downstream, of course. But *that* would take 'em to Hudson Bay, and there's no market for spruce timber or pulpwood at Hudson Bay." He pointed down the current.

"You're entirely mistaken," put in the Professor. "Any fool could see this river runs the other way. A log thrown in here would go down toward the St. Lawrence!"

"But then," asked the girl, "why can't we drift back to civilization?" The Professor retorted:

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Extraordinary, that I have to explain the obvious!" He walked away in a huff.

"I don't know but he's right, at that," half admitted the journalist. "I've been thinking almost the same thing, myself, the past day or two—that is, ever since the sun shifted."

"What do you mean, shifted?" from Jandron.

"You haven't noticed it?"

"But there's been no sun at all, for at least two days!"

"Hanged if I'll waste time arguing with a lunatic!" Marr growled. He vouchsafed no explanation of what he meant by the sun's having "shifted," but wandered off, grumbling.

"What *are* we going to do?" the girl appealed to Jandron. The sight of her solemn, frightened eyes, of her palm-outward hands and (at last) her very feminine fear, constricted Jandron's heart.

"We're going through, you and I" he answered simply. "We've got to save them from themselves, you and I have."

Their hands met again, and for a moment held. Despite the dead calm, a fir-tip at the edge of the clearing suddenly flicked aside, shrivelled as if frozen. But neither of them saw it.

THE fugitives, badly spent, established themselves in the "bar-room" or sleeping-shack of the camp. They wanted to feel a roof over them again, if only a broken one. The traces of men comforted them: a couple of broken peavies, a pair of snowshoes with the thongs all gnawded off, a cracked bit of mirror, a yellowed almanac dated 1899.

Jandron called the Professor's attention to this almanac, but the Professor thrust it aside.

"What do *I* want of a Canadian census-report?" he demanded, and fell to counting the bunks, over and over again. His big bulge of his forehead, that housed the massive brain of him, was oozing sweat. Marr cursed what he claimed was sunshine through the holes in the roof, though Jandron could see none; claimed the sunshine made his head ache.

"But it's not a bad place," he added. "We can make a blaze in that fireplace and be comfy. I don't like that window, though."

"What window?" asked Jandron. "Where?"

Marr laughed, and ignored him. Jandron turned to Vivian, who had sunk down on the "deacon-seat" and was staring at the stove.

"*Is* there a window here?" he demanded.

"Don't ask me," she whispered. "I—I don't know."

With a very thriving fear in his heart, Jandron peered at her a moment. He fell to muttering:

"I'm Wallace Jandron. Wallace Jandron, 37 Ware Street, Cambridge, Massachusetts. I'm quite sane. And I'm going to stay so. I'm going to save her! I know perfectly well what I'm doing. And I'm sane. Quite, quite sane!"

AFTER a time of confused and purposeless wrangling, they got a fire going and made coffee. This, and cube bouillon with hardtack, helped considerably. The camp helped, too. A house, even a poor and broken one, is a wonderful barrier against a Thing from—Outside.

Presently darkness folded down. The men smoked, thankful that tobacco still held out. Vivian lay in a bunk that Jandron had piled with spruce-boughs for her, and seemed to sleep. The Professor fretted like a child, over the blisters his paddle had made upon his hands. Marr laughed, now and then; though what he might be laughing at was not apparent. Suddenly he broke out:

"After all, what should *It* want of us?"

"Our brains, of course," the Professor answered, sharply.

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"That lets Jandron out," the journalist mocked.

"But," added the Professor, "I can't imagine a Thing callously destroying human beings. And yet—"

He stopped short, with surging memories of his dead wife.

"What was it," Jandron asked, "that destroyed all those people in Valladolid, Spain, that time so many of 'em died in a few minutes after having been touched by an invisible Something that left a slight red mark on each? The newspapers were full of it."

"Piffle!" yawned Marr.

"I tell you," insisted Jandron, "there are forms of life as superior to us as we are to ants. We can't see 'em. No ant ever saw a man. And did any ant ever form the least conception of a man? These Things have left thousands of traces, all over the world. If I had my reference-books—"

"Tell that to the marines!"

"Charles Fort, the greatest authority in the world on unexplained phenomena," persisted Jandron, "gives innumerable cases of happenings that science can't explain, in his 'Book of the Damned.' He claims this earth was once a No-Man's land where all kinds of Things explored and colonized and fought for possession. And he says that now everybody's warned off, except the Owners. I happen to remember a few sentences of his: 'In the past, inhabitants of a host of worlds have dropped here, hopped here, wafted, sailed, flown, motored, walked here; have come singly, have come in enormous numbers; have visited for hunting, trading, mining. They have been unable to stay here, have made colonies here, have been lost here.'"

"Poor fish, to believe that!" mocked the journalist, while the Professor blinked and rubbed his bulging forehead.

"I *do* believe it!" insisted Jandron. "The world is covered with relics of dead civilizations, that have mysteriously vanished, leaving nothing but their temples and monuments."

"Rubbish!"

"How about Easter Island? How about all the gigantic works there and in a thousand other places—Peru, Yucatan and so on—which certainly no primitive race ever built?"

"That's thousands of years ago," said Marr, and I'm sleepy. For heaven's sake, can it!"

"Oh, all right. But *how* explain things, then!"

"What the devil could one of those Things want of our brains?" suddenly put in the Professor. "After all, what?"

"Well, what do we want of lower forms of life? Sometimes food. Again, some product or other. Or just information. Maybe *It* is just experimenting with us, the way we poke an ant-hill. There's always this to remember, that the human brain-tissue is the most highly-organized form of matter in this world."

"Yes," admitted the Professor, "but what —?"

"*It* might want brain-tissue for food, for experimental purposes, for lubricant—how do *I* know?"

Jandron fancied he was still explaining things; but all at once he found himself waking up in one of the bunks. He felt terribly cold, stiff, sore. A sift of snow lay here and there on the camp floor, where it had fallen through holes in the roof.

"Vivian!" he croaked hoarsely. "Thorburn! Marr!"

Nobody answered. There was nobody to answer. Jandron crawled with immense pain out of his bunk, and blinked round with bleary eyes. All of a sudden he saw the Professor, and gulped.

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The Professor was lying stiff and straight in another bunk, on his back. His waxen face made a mask of horror. The open, staring eyes, with pupils immensely dilated, sent Jandron shuddering back. A livid ring marked the forehead, that now sagged inward as if empty.

"Vivian!" croaked Jandron, staggering away from the body. He fumbled to the bunk where the girl had lain. The bunk was quite deserted.

On the stove, in which lay half-charred wood—wood smothered out as if by some noxious gas—still stood the coffee-pot. The liquid in it was frozen solid. Of Vivian and the journalist, no trace remained.

Along one of the sagging beams that supported the roof, Jandron's horror-blasted gaze perceived a straight line of frosted prints, ring-shaped, bitten deep.

"Vivian! Vivian!"

No answer.

Shaking, sick, gray, half-blind with a horror not of this world, Jandron peered slowly around. The duffle-bag and supplies were gone. Nothing was left but that coffee-pot and the revolver at Jandron's hip.

Jandron turned, then. A-stare, his skull feeling empty as a burst drum, he crept lamely to the door and out—out into the snow.

SNOW. It came slanting down. From a gray sky it steadily filtered. The trees showed no leaf. Birches, poplars, rock-maples all stood naked. Only the conifers drooped sickly-green. In a little shallow across the river snow lay white on thin ice.

Ice? Snow? Rapt with terror, Jandron stared. Why, then, he must have been unconscious three or four weeks? But how—?

Suddenly, all along the upper branches of trees that edged the clearing, puffs of snow flicked down. The geologist shuffled after two half-obliterated sets of footprints that wavered toward the landing.

His body was leaden. He wheezed, as he reached the river. The light, dim as it was, hurt his eyes. He blinked in a confusion that could just perceive one canoe was gone. He pressed a hand to his head, where an iron band seemed screwed up tight, tighter.

"Vivian! Marr! Haallooooo!"

Not even an echo. Silence clamped the world; silence, and a cold that gnawed. Everything had gone a sinister gray.

After a certain time—though time now possessed neither reality nor duration—Jandron dragged himself back to the camp and stumbled in. Heedless of the staring corpse he crumpled down by the stove and tried to think, but his brain had been emptied of power. Everything blent to a gray blur. Snow kept slithering in through the roof.

"Well, why don't you come and get me, Thing?" suddenly snarled Jandron. "Here I am. Damn you, come and get me!"

VOICES. Suddenly he heard voices. Yes, somebody was outside, there. Singularly aggrieved, he got up and limped to the door. He squinted out into the gray; saw two figures down by the landing. With numb indifference he recognized the girl and Marr.

"Why should they bother me again?" he nebulously wondered. Can't they go away and leave me alone?" He felt peevish irritation.

Then, a modicum of reason returning, he sensed that they were arguing. Vivian, beside a canoe freshly dragged from thin ice, was pointing; Marr was gesticulating. All at once Marr snarled, turned from her, plodded with bent back toward the camp.

"But listen!" she called, her rough-knit sweater all powdered with snow. *"That's* the way!" She gestured downstream.

"I'm not going either way!" Marr retorted. "I'm going to stay right here!" He came on, bareheaded. Snow grayed his stub-

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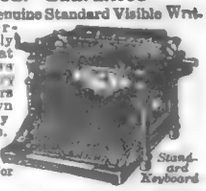

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How to Hook-Up A Transmitter Button to Make an Efficient Loud Talker

A Transmitter button with a few dry cells and a telephone receiver will make a remarkably simple and efficient loud talker. A Microphonic amplifier of this type is just the thing for use with a radio set. The weak music and signals may be amplified many times their original value. It is possible to entertain a large audience with a simple radio equipment if a transmitter button is used in the circuit as explained in diagram A.

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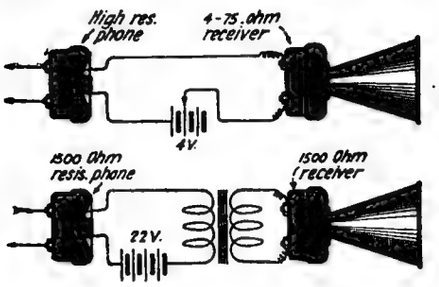
As may be seen in the diagram, two dry cells or a small storage battery are connected in series with the transmitter button and a 4 to 75 ohm telephone receiver. The transmitter button is secured to the diaphragm of the telephone in the radio receiving set. To accomplish this properly, scrape off the enamel (if diaphragm is enameled) on the face of the diaphragm and solder the small hexagon nut supplied with the button to the exact center. Care should be taken that the thin diaphragm is not bent or otherwise



harmed. The transmitter button is then screwed into place. Connections, as shown in the diagram, are made with flexible wire. A horn may be placed over the low resistance receiver if desired. When the radio set is properly tuned and signals are being received, the transmitter button is operated by the vibration of the diaphragm of the receiver. As the receiver diaphragm vibrates, the mica diaphragm on the transmitter button also vibrates. The carbon grains are compressed at varying pressure; the current flowing through the local battery circuit is thus varied and results in an amplification of the sounds in the low resistance telephone loud-talker.

Diagram B, which includes a step-up transformer, is to be used with loud talking receivers of high resistance. The primary of the transformers should have a resistance of about 75 ohms. An ordinary telephone induction coil will serve as the transformer in this circuit.

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—Adv.

ble of beard; but on his head it melted as it fell, as if some fever there had raised the brain-stuff to improbable temperatures. "I'm going to stay right here, all summer." His heavy lids sagged. Puffy and evil, his lips showed a glint of teeth. "Let me alone!"

Vivian lagged after him, kicking up the ash-like snow. With indifference, Jandron watched them. Trivial human creatures!

Suddenly Marr saw him in the doorway and stopped short. He drew his gun; he aimed at Jandron.

"*You* get out!" he mouthed. "Why in ——— can't you stay dead?"

"Put that gun down, you idiot!" Jandron managed to retort. The girl stopped and seemed trying to understand. "We can get away yet, if we all stick together."

"Are you going to get out and leave me alone?" demanded the journalist, holding his gun steadily enough.

Jandron, wholly indifferent, watched the muzzle. Vague curiosity possessed him. Just what, he wondered, did it feel like to be shot?

Marr pulled trigger.

Snap!

The cartridge missed fire. Not even powder would burn.

Marr laughed, horribly, and shambled forward.

"Serves him right!" he mouthed. "He'd better not come back again!"

Jandron understood that Marr had seen him fall. But still he felt himself standing there, alive. He shuffled away from the door. No matter whether he was alive or dead, there was always Vivian to be saved.

The journalist came to the door, paused, looked down, grunted and passed into the camp. He shut the door. Jandron heard the rotten wooden bar of the latch drop. From within echoed a laugh, monstrous in its brutality.

Then, quivering, the geologist felt a touch on his arm.

"Why did you desert us like that?" he heard Vivian's reproach. "Why?"

HE turned, hardly able to see her at all.

"Listen," he said, thickly. "I'll admit anything. It's all right. But just forget it, for now. We've got to get out o' here. The Professor is dead, in there, and Marr's gone mad and barricaded himself in there. So there's no use staying. There's a chance for us yet. Come along!"

He took her by the arm and tried to draw her toward the river, but she held back. The hate in her face sickened him. He shook in the grip of a mighty chill.

"Go, with—you?" she demanded.

"Yes, by God!" he retorted, in a swift blaze of anger, "or I'll kill you where you stand. *It* shan't get you, anyhow!"

Swiftly piercing, a greater cold smote to his inner marrows. A long row of the cup-shaped prints had just appeared in the snow beside the camp. And from these marks wafted a faint, bluish vapor of unthinkable cold.

"What are you staring at?" the girl demanded.

"Those prints! In the snow, there—see?" He pointed a shaking finger.

"How can there be snow at this season?"

He could have wept for the pity of her, the love of her. On her red tam, her tangle of rebel hair, her sweater, the snow came steadily drifting; yet there she stood before him and prated of summer. Jandron heaved himself out of a very slough of down-dragging lassitudes. He whipped himself into action.

"Summer, winter—no matter!" he flung at her. "You're coming along with me!" He seized her arm with the brutality of desperation that must hurt, to save. And murder, too, lay in his soul. He knew that he would strangle her with his naked hands, if need

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were, before he would ever leave her there, for *It* to work Its horrible will upon.

"You come with me," he mouthed, "or by the Almighty—!"

Mar's scream in the camp, whirled him toward the door. That scream rose higher, higher, even more and more piercing, just like the screams of the runaway Indian guides in what now appeared the infinitely long agao. It seemed to last hours; and always it rose, rose, as if being wrung out of a hmuan body by some kind of agony not conceivable in this world. Higher, higher—

Then it stopped.

Jandron hurled himself against the plank door. The bar smashed; the door shivered inward.

With a cry, Jandron recoiled. He covered his eyes with a hand that quivered, claw-like.

"Go away, Vivian! Don't come here—don't look—"

He stumbled away, babbling.

Out of the door crept something like a man. A queer, broken, bent over thing; a thing crippled, shrunken and flabby, that whined.

This thing—yes, it was still Marr—crouched down at one side, quivering, whimpering. It moved its hands as a crushed ant moves its antennæ, jerkily, without significance.

All at once Jandron no longer felt afraid. He walked quite steadily to Marr, who was breathing in little gasps. From the camp issued an odor unlike anything terrestrial. A thin, grayish grease covered the sill.

Jandron caught hold of the crumpling journalist's arm. Marr's eyes leered, filmed, unseeing. He gave the impression of a creature whose back has been broken, whose whole essence and energy have been

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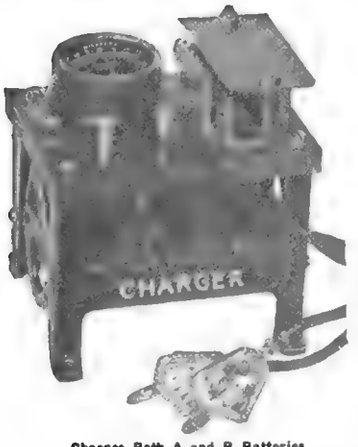

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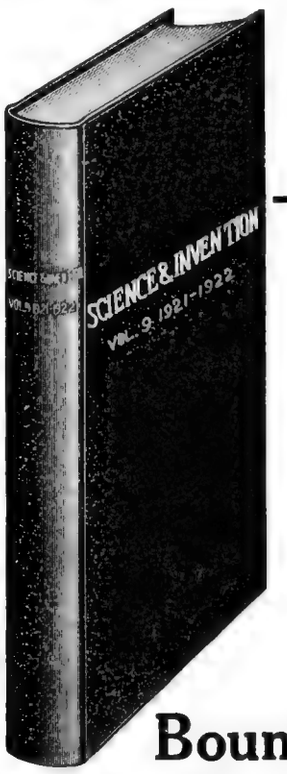

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wrenched asunder, yet in which life somehow clings, palpitant. A creature vivisected.

Away through the snow Jandron dragged him. Marr made no resistance; just let himself be led, whining a little, palsied, rickety, shattered. The girl, her face whitely cold as the snow that fell on it, came after.

Thus they reached the landing at the river.

"Come now, let's get away!" Jandron made shift to articulate. Marr said nothing. But when Jandron tried to bundle him into a canoe, something in the journalist revived with swift, mad hatefulness. That something lashed him into a spasm of wiry, incredibly venomous resistance. Salvers of blood and foam streaked Marr's lips. He made horrid noises, like an animal. He howled dismally, and bit, clawed, writhed and grovelled! he tried to sink his teeth into Jandron's leg. He fought appallingly, as men must have fought in the inconceivably remote days even before the Stone Age. And Vivian helped him. Her fury was a tiger-cat's.

Between the pair of them, they almost did him in. They almost dragged Jandron down—and themselves, too—into the black river that ran swiftly sucking under the ice. Not till Jandron had quite flung off all vague notions and restraints of gallantry; not till he struck from the shoulder—to kill, if need were—did he best them.

He beat the pair of them unconscious, trussed them hand and foot with the painters of the canoes, rolled them into the larger canoe, and shoved off.

After that, the blankness of a measureless oblivion descended.

ONLY from what he was told, weeks after, in the Royal Victoria Hospital at Montreal, did Jandron ever learn how and when a field-squad of Dominion Foresters had found them drifting in Lake Moosawamkeag. And that knowledge filtered slowly into his brain during a period inchoate as Iceland fogs. That Marr was dead and the girl alive—that much, at all events, was solid. He could hold to that; he could climb back, with that, to the real world again.

Jandron climbed back, came back. Time healed him, as it healed the girl. After a long, long while, they had speech together. Cautiously he sounded her wells of memory. He saw that she recalled nothing. So he told her white lies about capsized canoes and the sad death—in realistically-described rapids—of all the party except herself and him.

Vivian believed. Fate, Jandron knew, was being very kind to both of them.

BUT Vivian could never understand in the least why her husband, not very long after marriage, asked her not to wear a wedding-ring or any ring whatever.

"Men are so queer!" covers a multitude of psychic agonies.

Life, for Jandron—life, softened by Vivian—knit itself up into some reasonable semblance of a normal pattern. But when, at lengthening intervals, memories even now awake—memories crawling amid the slime of cosmic mysteries that it is madness to approach—or when at certain times Jandron sees a ring of any sort, his heart chills with a cold that reeks of the horrors of Infinity.

And from shadows past the boundaries of our universe seem to beckon Things that, God grant, can never till the end of time be known on earth.

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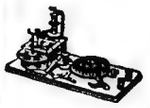

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Carbon Transmuted into Helium

(*Continued from page* 1167)

surrounding arc flame. These lines were found to correspond to those produced by helium. However, we thought that these might be produced by small quantities of helium gas which were present in the electrodes themselves, and which became noticeable in the intense heat.

"Further experimentation was in order, and we used various kinds of carbon with the same result. Graphite was used, which in itself had been heated in manufacture to a degree which barred the possibility of any contamination from helium. Still these lines were present. Indications of hydrogen were also found in the spectrum, but we practically proved that these were due to water vapor absorbed by the soft carbon electrodes, and not to disintegration."

The two investigators now set up apparatus in two different rooms as shown in the accompanying diagram, so as to better study the inner core of the arc. After all manner of tests with various types of carbon, they still found the lines indicating the presence of helium gas.

The investigators next attempted to take photographs of the arc showing the inner core, and the most successful result is shown herewith. Elaborate experimentation and preparation were necessary before obtaining this photograph, as screens of various types and colors of glass had to be tried, placed between the lines and the arc in order to produce a photograph without any accompanying halation. The color of the core flame is a pale purplish.

When questioned about the commercial possibilities of his and his colleague's investigations, Mr. Bassett said, "I do not believe that this method of producing helium will ever become commercially practical for the simple reason that probably only one atom of carbon in a billion is changed into helium. Our theory is that the heat and electrical force combine to smash the carbon atoms against each other, with such great impact, that occasionally one of them is broken up into helium. We do not make any claims that we will be able to inflate balloons, or even produce enough helium to detect other than with the use of the spectroscope."

These discoveries were made by Dr. Bell and Mr. Bassett, during a series of experiments with the Sperry arc searchlight, wherein they supplied a current of 150 amperes to the arc, a much higher current than had heretofore been used. They thus produced a heat of 9000°F, and a light greater than that of the sun. It has been calculated that the light of the sun at high noon on a cloudless day in this part of the country, is 920 candle power per square millimeter, while that produced by this arc is 1200 candle power per square millimeter. Anyone who has ever seen the electric arc used in motion picture machines can appreciate the above figures when told that the ordinary motion picture arc only furnishes a light of approximately 160 candle power per square millimeter.

What the results of these experiments will eventually be, is hard to realize, for the investigators are dealing with a hitherto unknown phenomenon. It is hoped that they will be able to develop their experiments to a point where appreciable quantities of hellium will be developed.

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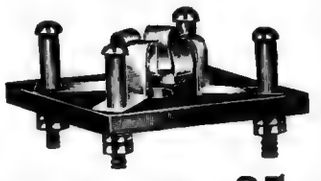

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Pipe, Cigar or Cigarette?

By ISWAR GINSBERG

(*Continued from page* 1161)

the smoke imparting a creosote-like odor to the tobacco. After curing the tobacco is moistened and allowed to ferment or sweat. The temperature rises during this process and the tabacco is changed from green to the familiar rich brown. It is during this process that a part of the nicotine disappears. Ammonia is liberated, indicating a breaking down of nitrogenous products, including nicotine and injurious and objectionable albuminoids. Excess nicotine is thereby destroyed; this action is very likely brought about or assisted by bacteria.

Sun-cured Virginia tobacco contains about 3 to 3.5 per cent nicotine, Kentucky tobaccos has about 4.5 per cent while some very strong Missouri tobacco, used for chewing, contains as high as 6 per cent nicotine. In general tobacco contains from 2 to 3 per cent nicotine although fine grades of Havana tobacco are known to contain about 0.5 per cent nicotine. German tobacco contains about 3.5 per cent nicotine, Java tobacco about the same amount, Chinese tobacco about 2.5 per cent. Average smoking tobacco contains about 2.85 per cent nicotine, but some of the ingredients of the smoking mixtures, such as perique runs much higher, sometimes as high as 5.5 per cent. For this reason perique tobacco is seldom smoked alone. Both Turkish and Egyptian tobaccos are comparatively low in nicotine, from 1 to 1.5 per cent in the former and about 1.75 per cent in the latter.

It is clear from the above figures that there must be other ingredients in the tobacco which have an important effect on its flavor and aroma. Tobacco contains resins, fats, starch, glucose, mineral matter, etc., which all exert some influence on the quality of the same. A good many of these substances are not present in the original green leaf but are developed during the curing and sweating treatment.

There is accordingly on the average about 2 to 3 per cent of nicotine in tobacco. However, the important consideration is how much of this nicotine is to be found in tobacco smoke. The determinative factor in this regard is the manner in which the tobacco is burnt and the opportunity afforded the smoke to absorb nicotine from the tobacco in its passage through the unburnt portion. It is rather a difficult thing to determine how much of the nicotine is present in tobacco smoke, and this is due to one fact only, viz., the uncertainty of the chemical analytical methods. It is held variously that from 25 to 75 per cent of the nicotine in the original tobacco is present in the tobacco smoke.

It appears very likely that by far the greater proportion of the nicotine is destroyed in the process of smoking, when the burning is comparatively complete. There is no doubt that tobacco smoke contains nicotine and moreover it contains other products of combustion, such as carbon dioxide, formaldehyde, ammonia, hydrocyanic acid and other substances. The aggregate of all of these substances is so small, that they probably do not have any marked effect on the human system.

There is one rather striking fact, which would appear to indicate that the nicotine, drawn into the mouth along with tobacco smoke does not have the same chance to exert its strong physiological action, as when it is taken in solution or by the mouth. For example, a cigar of average size, made from tobacco containing about 2 per cent of nicotine, will yield enough nicotine in the to-

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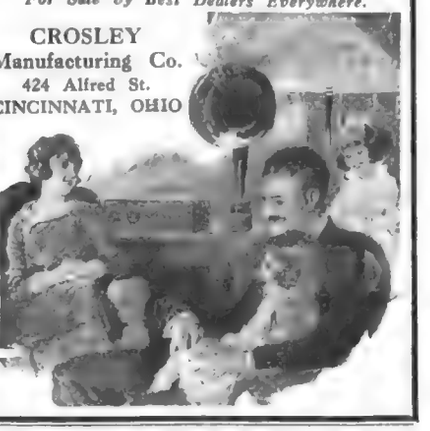

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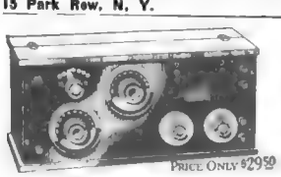

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bacco smoke, on the assumption that 75 per cent of the nicotine is destroyed through combustion, to amount to more than four times the minimum fatal internal dose of the alkaloid. There is no doubt that the action of nicotine in the tobacco smoke is different from its action when the substance is introduced directly into the stomach.

We now come to the final point to be considered, viz., the effect of the manner of smoking tobacco on the percentage of nicotine retained in the tobacco smoke. Tobacco is commonly used in the form of cigarettes, cigars and in pipes. In which case is the most nicotine found in the smoke? Tests have been made to determine this by exhausting the smoke from a burning cigarette, cigar and pipe throught glass tubes, containing absorbent paper, which will remove all the nicotine in the smoke. Chemical analysis will then give the percentage of nicotine.

The lowest percentage of nicotine was found in the smoke from the cigarette. The cigarette tobacco burns with the highest temperature and the smoke has the least possible chance to absorb nicotine from the unburnt tobacco. In the cigar the combustion of the tobacco is not quite so complete, so that cigar smoke generally contains more nicotine than does cigarette smoke. The smoke from the pipe conatins the most nicotine, for there the combustion is least complete and the smoke has the most chance to carry nicotine from the unburnt tobacco.

A few figures will illustrate these facts. Virginia cigarettes, containing 1.40 per cent nicotine in the tobacco, produced a smoke which contained only 0.12 per cent of the alkaloid. Turkish cigarettes, made from a tobacco containing 1.38 per cent nicotine, gave a smoke with a content of 0.51 per cent nicotine. A Havana cigar, made from a 0.64 per cent nicotine tobacco, produced a smoke containing about 0.20 per cent nicotine. Tobacco mixture, containing 2.85 per cent nicotine, yielded a smoke containing 0.33 per cent nicotine.

In conclusion it may be stated that only a comparatively small percentage of the nicotine, originally in the tobacco, finds its way into the smoke. The other products that are produced in the burning of the tobacco undoubtedly have some influence on the human system and take some part in the physiological effect produced by tobacco smoke, have but little chance to exert their potent physiological effects and the extent of their poisoning action is probably slight.

A Mechanical Quartermaster

(*Continued from page* 1167)

continue the course laid out by previous manipulations. The correcting factors adjusted by the tiny knobs, shown in the illustration, must be changed when a ship is loaded down, or when empty, as the inherent yaw to be allowed to the ship will differ with its load. Any departure from the course, as small as ten minutes of arc, causes the gyro-repeater system and the electrical relays to operate the steam steering engines, whereas a quartermaster even though very expert, could seldomly detect a departure as small as one degree from a course. The gyroscopic steering feature is going to be installed on the S.S. Leviathan when she leaves her dock, laboriously turning as she reaches mid-stream, and steams toward Europe early in May of this year after being completely refitted.

—Photos, Courtesy Sperry Gyroscope Co.

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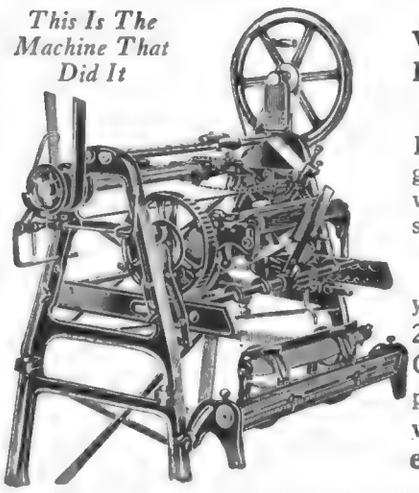

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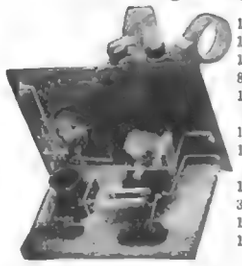

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Wave-Traps and Interference Preventers

By A. P. PECK

(*Continued from page* 1193)

used as in Fig. 1, but they are connected in shunt with the primary of the receiving transformer. The same detector circuit as in Fig. 1 may also be used. Here the same tuning procedure is used as given above. The theory of this circuit is that the primary of the vario-coupler or receiving transformer is tuned to the desired wave length, while that of the wave-trap, is tuned to the undesired wave. Therefore, the latter passes through the wave-trap to the ground without affecting the secondary of the vario-coupler.

A general rule may be stated for both of the above wave-traps, and this rule says that they should be thoroughly shielded from the receiving set. The best way to do this would be to mount the inductance coil, the condenser and the switch in a small cabinet, the inside of which is lined with tin foil, and the tin foil grounded. In lining the box with the foil, be sure that the latter does not touch any metallic part of the instruments. For experimental purposes, the coil, switch and condenser may be placed on a table separated by several feet from the receiving instruments. These precautions are necessary so that the electro-magnetic field set up around the inductance coil of the wave-trap will not effect the secondary circuit of the receiving set.

A very selective tuner, known as the wave filter, is shown in Fig. 3. A glance at the part of the circuit to the left of the dotted line will reveal a standard short wave regenerative tuner consisting of a vario-coupler and two variometers. The only additions to this apparatus necessary to construct this filter, are two vario-couplers and two variable condensers. The former may be any standard make capable of tuning to the same wave as the coupler used in the receiving set, and the variable condensers should have a capacity of .001 M.F.

In practice, the three couplers and the three variable condensers are all tuned to the desired wave. The variometers are then balanced to secure regeneration. This set will be rather hard to tune, but the selectivity it affords will make up for any trouble in learning to operate it. If a three coil honeycomb tuner is being used, the four coils represented by the primaries and secondaries of the first two vario-couplers, may consist of four honeycomb coils, the primary ones of the same size as the primary of the tuner, and the secondaries of the same size as the secondary coil in the tuner. The theory of this circuit is that all the circuits are tuned to pass the frequency of the desired incoming wave. Now in the first transformation, the undesired signals will be cut down somewhat, because the circuits are not tuned to their frequency. In the second transformation the same signals will be reduced in strength still further, while in the third transformation, they will in the majority of cases, be eliminated. This circuit, when tuned properly, should pick out one or more of two transmitting stations operating on close wave lengths, such lengths being within 3 meters of each other.

An ultra-selective, yet easily made tuner, is illustrated in Fig. 4. The tuning coil which is equipped with 5 sliding contacts, may be made by winding about 100 turns of No. 20 or No. 22 D.C.C. wire on a cardboard or bakelite tube 3½ inches in diameter. The two variable condensers used should have a capacity of .001 M.F. When the two sliders

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connected to the aerial are symetrically arranged in relation to the sliders connecting to the detector, and the slider connected to the ground, the detector will not be affected by any incoming signals. To receive the desired signals, the slider connected to the ground, should be shifted to the right or left as the case may be, until the station is heard loudest. Various arrangements of the sliders will give different results, and tests should be made to determine just what setting is best for receiving a particular wave. This circuit will function equally well with either a crystal or audion detector.

What is known as the Fessenden differential tuner, is shown in Fig. 5. A standard variometer is used to tune the antenna circuit, while two vario-couplers of exactly the same construction, are used in the rest of the circuit. The variable condensers used in series with the two primaries, should have a capacity of .001 M.F. After the circuit is connected as shown, the switch is opened, and the left hand coupler and variable condenser tuned until the desired signals are heard loudest in the phones; the switch is then closed, and the right hand coupler-circuit tuned, until any interfering signal is eliminated. It may be found that the circuit does not attract properly at first, in which case the connections to one of the secondaries should be reversed. It will generally be found that the variable condenser in series with the primary of the right hand vario-coupler should be set so that its capacity will be approximately 5% more than the capacity of the other condenser. The theory of this circuit is that neither side of the circuit being in tune with the undesired signals, they are practically choked out, while the desired signals to which the circuits are in tune, will pass freely through both sides of the circuit, affecting the secondaries, and producing audible signals in the phones. This circuit will be found very efficient for use with a crystal detector, even when comparatively close to the interfering or unwanted station.

A very efficient circuit for the elimination of interference with a loop antenna and two vacuum tubes is shown in Fig. 6. Detector and amplifier tubes are necessary for use in this circuit, the radio-frequency amplifier being the left hand tube, and the detector the right hand tube. The primary of the regenerative coupler shown should be wound on a cardboard or bakelite tube 4 inches in diameter, and should consist of 18 turns of No. 14 or No. 16 D.C.C. wire. A rotor should be mounted within this tube, and should be wound with 60 turns of No. 28 or No. 30 S.C.C. wire. Neither winding need be tapped. This circuit comprises one stage of radio-frequency amplification and a detector, the special coupler acting as a combination radio-frequency transformer and a feed-back. The tuning is very sharp when used with a loop antenna. It would be well to provide verniers for both condensers as well as to fasten a long rod to the knob of the regenerative coupler so that it may be accurately adjusted. The grid leak should preferably be variable, but a value of about 2 megohms will generally be found satisfactory. For those who desire to use this circuit with an outdoor antenna the supplementary circuits 6-A and 6-B are given. In the former a two-slide tuner is used between the antenna and ground, and the points marked A and B are connected to the points similarly marked on Fig. 6. The winding of this two-slide tuner may be the same as given for the tuning coil in Fig. 4, the only difference being that it is equipped with two instead of five sliders.

A vario-coupler or loose-coupler may be used as shown in 6-B. The antenna is connected through a .001 M.F. condenser to the primary of the vario-coupler, the other side of which is connected to the ground. The rotor is then connected to the points marked A and B on Fig. 6.

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Cheap vs. Standard Apparatus

By BERT T. FERENCZ

(*Continued from Page* 1192.)

rolling the prepared sheets together. A hardened courage is required to sell these "grid leaks" without incurring the displeasure of a troubled conscience.

A pertinent example is a manufacturer who labelled his article "C.W. condenser". An unsuspecting amateur with a C.W. apparatus would find considerable trouble arising from the use of this particular condenser in his set. However, the manufacturer is after other things besides dependability and service; sales count most with him. And how the rated values vary! A 0.0005 mfd. measured up as 0.000969 mfd. A 0.006 mfd. gave a reading of 0.009 mfd. Some come real close to the mark; a 0.00025 mfd. reads 0.00031 mfd., a 0.001 mfd. measured 0.000851 mfd. Sometimes the manufacturer even hits the mark, viz.: A .0005 mfd. when placed on the capacity bridge, measured 0.000553 mfd. The losses of 10,000 ohms are considered as not worth bothering about.

Even mica insulated condensers can be poorly made. One such condenser measured 3700 ohms for the equivalent dielectric loss. If the construction of any fixed condenser is such that the conducting surface is not intimately in contact with the dielectric, losses are bound to occur, even when good materials are used in the assembly.

As regards variometers, the popular notion seems to favor those with moulded bakelite or condensite forms. This is an erroneous preference. These phenol products possess good insulating properties to be sure, but the dielectric losses are high. Using such material in the high frequency field of a variometer increases the resistance enormously. Hard rubber forms are to be preferred; even wood is better. but the best results can be obtained from a variometer whose windings contain no dielectric in the high frequency field; i.e., are self-supporting or of the basket wound type. Pigtail connections to the rotor are to be preferred or else a long wiping electrical contact through the bearing system.

Tube sockets are another fertile source of trouble. In the endeavor to produce low cost equipment some manufacturers have used cellulose compositions, inferior hard rubber compositions and even fibre. One such socket gave an insulation resistance of only 28 megohms. Is it to be wondered then that the tube placed in such a socket will hardly detect? How can it when the grid has a high positive charge on it, due to leakage across the base from the plate terminal? Attempt to solder a wire on a terminal of a rubber composition socket and note how easily the heat softens the material. The fact that both screw and contact springs are loosened, not to mention the ruined socket, should not irritate the builder.

Since radio frequency amplification is attracting a great deal of attention, it may be of interest to cite one or two cases of selling tactics. One manufacturer stated that his radio frequency transformers would cover a range of from 150 to 700 meters. When three of these transformers were put under actual test, they showed a fair amount of amplification at around 370 meters but very meagre operation at other wave lengths. Another radio frequency amplifying device based on the choke coil principle was supposed to work *efficiently* at from 250 to 400 meters wave length. It gave a sharp peak at 265 meters with practically no amplification at other wave lengths.

Aerial insulators of all kinds are sold, imitations of a well-known make. When examined, they present a fuzzy appearance

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at the joint where the mould closes. Scratching this place with a knife reveals cotton waste, wood splinters, some ground stone and other "good" insulating material. Unglazed porcelain insulators should not be used due to the fact that moisture and dirt seep into the pores of the porcelain and reduce its resistance. In passing, it may be worth noting that thoroughly glazed porcelain insulators are best where not too great a strain is placed on them.

From the foregoing statements, it can be deduced that standard grade apparatus is cheaper in the end. The energy received over the antenna is small enough as it is, (a few micro-amperes) without having to traverse poorly designed and inefficient apparatus in addition. It is costly to experiment with material that one can but throw away after a very short time, while approved instruments give satisfactory and lasting service. A decided step in the right direction, from the manufacturing point of view, is the elimination from the field of radio goods manufacturers and dealers through various causes, of a great many button and bead manufacturers, clothing manufacturers, hair-net manufacturers and other "radio" companies, who thought only of the monetary side of radio when the boom came on a year ago. Those companies that are left are pretty well convinced of the fact that only worthy material will stand the test of time.

Telegraphing Pictures by Code

By D. W. ISAKSON

(*Continued from page* 1168)

Telegraph rules permit five letters to a word in code messages. These are utilized as follows: The first indicates the prime division on the vertical scale containing the ordinate indicated by the second letter. The third indicates which of the prime divisions of the horizontal scale contains the abscissa indicated by the fourth letter. As an instance TEDK is the co-ordinate of ordinate E in prime division T and abscissa K of prime division D. The fifth indicates the nature of the line according to the above tabulation. When the circumscribing line is completed, i. e., brought back to the point of beginning, the fifth letter gives the shading to be filled in. Other letters are used to indicate clouds, marine, a throng of people, etc.

The entire process is illustrated in figures 1 to 6. A sample of the code is seen in figure 3.

Some excellent results have been obtained from this system and though its scope of application is limited to some extent to photographs of no great amount of detail it possesses a number of advantages. For instance there is no limit to the number of times a photogram may be relayed and the process lends itself to radio as well as wire telegraphy, nor is it subject to distortion from static and magnetic disturbances.

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It is likely that the mails will be an important factor in the distribution of telegraphed pictures even when efficient mechanical systems are evolved. Copies from one received photograph may thus be made to serve probably a hundred newspapers or more, depending upon the population within the zone.

(Photos courtesy Journal of American Institute of Electrical Engineers.)

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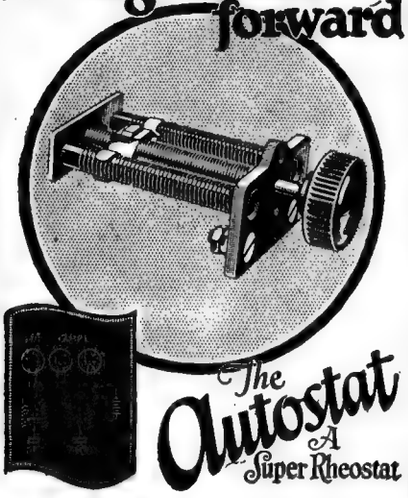

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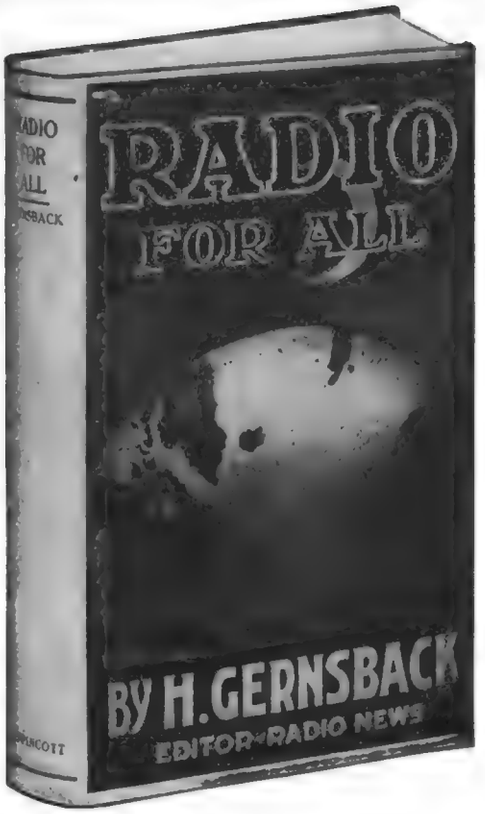

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By H. GERNSBACK

Editor "Radio News," "Science and Invention" and "Practical Electrics"

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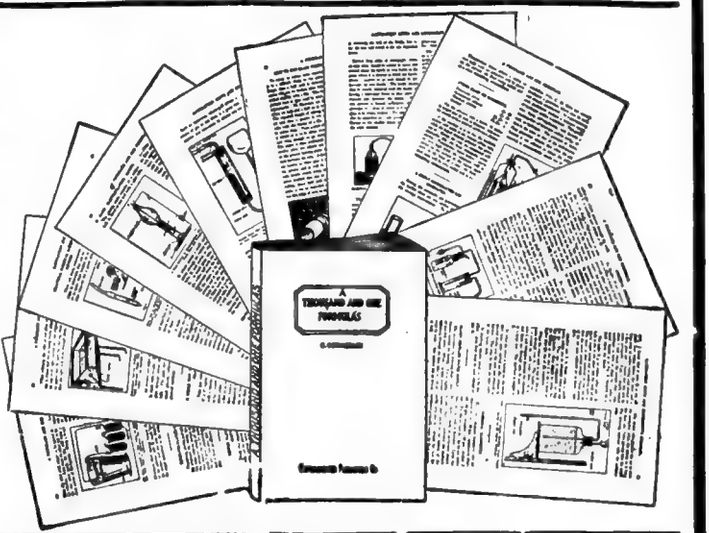

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Gassing the Burglar

By ERIC A. DIME

(*Continued from page* 1155)

produces 200,000 candle power, and the report of the exploding shell can be heard for a distance of five miles or more.

The illumination from the star shells immediately attracts attention to the building broken into by the burglar. This building can be quickly located by means of a slowly-burning colored light, or flame, which issues from a special cartridge placed in the group of the star shell cartridges in the candelabrum.

How to Use Your Camera

By DR. ERNEST BADE

(*Continued from page* 1184)

one second, speed and examine the resulting picture for distortion of the bright object. A much simpler method of procedure is to work with a pendulum. One approximately 96 cm. in length (39 1/10 inches in New York), vibrates once each second. At the end point of the swing, the picture of the pendulum on a white background is taken. If distorted, the shutter is slower than indicated, and this must be taken into account in practical photography.

Exposures can be made for a stereoscope with an ordinary camera provided both pictures are taken immediately after each other, the second being taken 6 to 7 cm. (the distance between the pupils of the eye) away from the first. For such photographs it is advantageous to make a board provided with two lateral strips which permit the camera to be shifted this distance. Then the first picture is taken at one side of the board while the second is taken at the other. The coloring of such stereoscopic photographs is not at all difficult.

Handy Letter Scale

(*Continued from page* 1186)

Next make a small hole in the front end of the ruler and drive into it a short pin, made by cutting off an ordinary pin. Bend this downward about ⅛ inch and upward about the same, so as to form a hook, which is to hold whatever is to be weighed. Remember that the article should hang freely and be sure that it does not touch the table. To calibrate the scale, proceed as follows: Put the staple in the bottom holes and place the ruler so that it rests on this fulcrum, with the hook projecting an inch or two beyond the edge of the table. Fig. 4 shows this position. Then from the hook suspend the one-ounce package. If necessary, attach a piece of thread to the string, but it may be that a long enough end has been left. Be sure that the package swings freely, neither touching the ruler nor the table. Place the slug on the ruler, and keeping it even with the back edge, move it until the scale balances. Have the beveled edge of the slug to the left, and as soon as you get a balance, make a mark at the bevel, using a very sharp pencil. This mark gives you your first point. Take the 2, 3, and 4-ounce packages in sequence and proceed with the calibration in the same way.

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OTHER USES

The above, however, does not exhaust the uses of the "RICO" **Phonodapter,** because it can be used in connection with standard horns. It is realized that it is almost impossible to fit the "RICO" Loud Speaker 'Phone, or, for that matter, any receiver, to a horn, if you should happen to have such, without an adapter. The "RICO" **Phonodapter** can be used to couple any 'phone to a horn, if you have a spare horn lying about. Or if you know where you can obtain one, the **Phonodapter,** will solve your difficulty. If you do not wish to go to the expense of a horn, and wish to improvise one it can be easily made by rolling and pasting together a sheet of stiff Bristol Board and fashioning it into a horn. If the lower extremity is fitted over the brass tube of the "RICO" **Phonodapter** you will at once have a horn which in an emergency will prove quite satisfactory. Such horns can be made as large as desired. We guarantee the **Phonodapter** to do all that we say, and shall cheerfully refund the purchase price if it is not found satisfactory in all respects.

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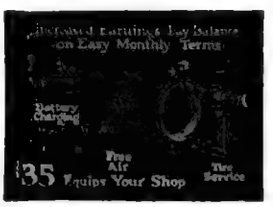

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Substitute for Vacuum Tube Socket. Four of these take one Vacuum Tube. Grasp tube firmly. Best contact possible. Take less room. Are better.

R-1550, Sockettes, nickeled, set of 4 .....$.25

R-1551 Sockettes, nickeled, set of 4 (to take WD-11 Tube) ..... .25

Note: Set of 4 sufficient to hold 1 Tube.

VACUUM TUBE FUSES

Insure your tubes against blow outs.

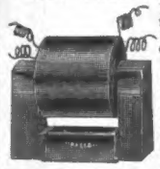
R-2575, Fuse, 1 ampere.....$.15
R-2576, Fuse, 1½ ampere ..... .15
R-2577, Fuse, 2 ampere ..... .15

UNIVERSAL BEARING

THE bearing to hold variometer and variocoupler rotors. Total length of bearing 2¼". Outside shaft, 1¼". Length of thread 1". Length of threaded sleeve, ⅝"

R-1375, Bearing .....$.25

AUDIO FREQUENCY TRANSFORMERS



No better Transformer on the market. Highest class materials. Impregnated coils. Silicon steel stampings used. Save 50 per cent by assembling it yourself.

R-1100, A.F. Transformer, ratio 4¼ to 1 .....$2.65

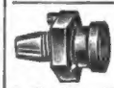
R-1150, A.F. Transformer, ratio 6½ to 1 ..... 2.65

HONEYCOMB COILS

No better coils on the market. Too well known for lengthy description. Firm impregnation. Range given is in meters when varied with a .001 Variable Condenser:

No.	Turns	Range	Price
R-5000	25	120- 250	$ .40
R-5001	35	175- 450	.45
R-5002	50	240- 720	.50
R-5003	75	390- 910	.55
R-5004	100	500- 1450	.60
R-5005	150	600- 2000	.65
R-5006	200	900- 2500	.75
R-5007	250	1200- 3500	.80
R-5008	300	1500- 4500	.85
R-5009	400	2000- 5000	1.00
R-5010	500	2800- 6100	1.15
R-5011	600	4000-10000	1.30
R-5012	750	5000-12000	1.45
R-5013	1000	7900-15000	1.70
R-5014	1250	9750-19500	1.95
R-5015	1500	14500-26500	2.20

CORD TIP JACKS



Take the place of binding posts on instruments or panel. Cord tip firmly gripped by jack. Made of brass, highly nickel-plated and polished. Screw to attach lead wire. No soldering necessary.

R-1500, Cord Tip Jack, each.....$.15

CARDBOARD TUBING

Only seamless tubing made in United States. Perfectly seasoned. Heavy wall. (I.D.—Inside Diameter. O.D.—Outside Diameter. L.—Length).

R-6600, 3" I.D., 3¼" O.D. x 7" L. .....$.30
R-6601, 3⅛" I.D., 3⅜" O.D. x 7" L..... .35
R-6602, 3¼" I.D., 3½" O.D. x 5" L..... .25
R-6603, 3⅜" I.D., 4" O.D. x 5" L..... .27
R-6604, 4" I.D., 4⅛" O.D. x 5" L..... .35
R-6605, 2⅜" I.D. 3" O.D. x 2⅜" L..... .15

MICANITE TUBING

Especially suitable for CW work Nothing better made. Natural color.

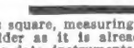
R-250, Micanite Tubing, 4" dia., 6" long $1.20
R-251, Micanite Tubing, 6" dia., 6" long 1.60

JACKS AND PLUGS

Best material. Only pure silver contacts used. Factory that makes Postal Telegraph jacks makes these. This is your guarantee.

R-1000, Jack, 4-springs double circuit .....$ .75
R-1001, Jack, 3-springs .80
R-1002, Automatic 5-spring Jack..... 1.00
R-1003, Plug ..... .65

BUS BAR WIRE



This wire is square, measuring 1/16" by 1/16". Easy to solder as it is already tinned. Used on all up-to-date instruments. Sold in 2-foot lengths only.

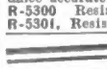
R-6400 Bus Bar Wire, per 2-foot length..$.05

NON-INDUCTIVE RESISTANCE

Made of special graphite copper-plated at the ends. Round rods 1¾" long, ¼" diameter. Resistance accurate within 20 per cent.

R-5300 Resistance 12,000 ohms.....$.65
R-5301, Resistance 70,000 ohms..... .65

BRASS RODS



Sold in 6" lengths only

R-8032, Brass Rod, 8/32" thread, per length .....$.08
R-6032, Brass Rod, 6/32" thread, per length ..... .06
R-1425, Brass Rod, plain ¼" round, per length ..... .10
R-3616 Brass Rod, plain 3/16" round, per length ..... .06

"RASCO" BABY DETECTOR

Base is solid black composition; mounted on same is nickel holder and binding post, which holds the fluted hard rubber knob with its sliding rod member. Patent nickel detector cup and binding post. Patent cup holds crystal.

R-1898, Baby Detector, with Galena .....$.50

"RASCO" LUBRICATED PANEL SWITCH

Our patent spring fork holds the switch handle always at a uniform tension. At the same time it insures best contact possible. New wiping contact covers every portion of the switch point. Double leaf blades used.

R-1921, "Rasco" Switch .....$.40

PANEL SWITCH LEVER

Impossible for this lever not to make positive contact. Leg radius 1¾". Nickel-plated and polished. Lock fork holds the screw (in which it rotates) securely. Loose contact impossible.

R-200, Switch Lever .....$.30

"RASCO" NAME PLATES

The circular plate is our new Binding Post Name Plate. Diameter, ¾". These denominations: PHONES, GROUND, —, OUTPUT, "A" BATTERY—, "B" BATTERY—, LOUD SPEAKER, GRID, LOAD, "C" BATTERY—, AERIAL, +, INPUT, "A" BATTERY+, "B" BATTERY +, LOOP, TICKLER, PLATE, "C" BATTERY +, FILAMENT.

R-6000 to 6019, Binding Post Name Plates, each denomination .....$.03
Dozen ..... .30

Square Name Plates

Same denominations as above also these: SERIES 1st STEP, 2nd STEP, 3rd STEP, SECONDARY CONDENSER, TELEPHONE, SECONDARY, DETECTOR, TRANSMIT, GRID VARIOMETER, PARALLEL, COUPLING, PRIMARY, LOADING COIL, RECEIVE, ANTENNA, PLATE VARIOMTER, "BLANK", AUDION, ON, OFF.

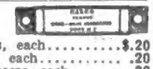
R-834 to 866, Square Name Plates, each..$.04
Dozen ..... .40
R-839 "INCREASE CURRENT" (Right)
R-840 "INCREASE CURRENT" (Left)
Each ..... .10

VERNIER

Cleverest vernier made. Can be used with any dial. Soft rubber ring engages dial. Does away with vernier condenser. We guarantee results. All metal parts moulded in best black composition. Nothing to come apart. Biggest hit of the season.

R-1450, Vernier .....$.30

"RASCO" CONDENSERS



R-5050, Phone Condensers, each.....$.20
R-5056, Grid Condensers, each..... .20
R-5059, Grid Leak Condensers, each ..... .30

COPPER FOIL

Thinnest copper foil made, .001" thick. Comes 4" wide.

R-5025, Copper Foil, per ft. $.10
10-ft. length ..... .80

RADIO CEMENT

Weather resisting. Used particularly for cementing covered wires. Coils covered with this cement require no form. Wires hold together solely with this cement.

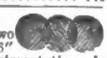
R-1750, Cement, 2-oz. bottle $.50

TELEPHONE SHELL AND CAP

For the experimenter we list this composition shell and cap. No holes in shell whatsoever. Takes standard 2½" diaphragm.

R-2700, Shell-and-Cap, complete .....$.65
R-2701, Shell only ..... .40

MICA DIAPHRAGMS



Made of special India mica in two sizes, 2⅛" diameter and 1-13/16" diameter. Excellent for experimentation in telephone work.

R-2550, Diaphragm, 2⅛" .....$.20
R-2551, Diaphragm, 1-13/16" ..... .15

RHEOSTAT WINDINGS

These windings, with the switch arm shown below, constitute a complete rheostat for the experimenter. Resistance wound on flexible black fibre. Carries 1⅛ amperes, resistance 6 ohms.

R-4300, Rheostat Resistance each .....$.20
R-4301, Potentiometer Resistance, each (200 ohms) .. .35

BLADE WITH COLLAR

Fits above.

R-1675, each .....$.10

MAGNET WIRE

We list only best qualities. "DCC" means Double Cotton Covered. "GS" means Green Silk. "E" stands for Enameled. The following come on 8-ounce spools:

R-2500, DCC No. 18.....$ .50
R-2501, DCC No. 20..... .60
R-2502, DCC No. 22..... .75
R-2503, DCC No. 24..... .85
R-2504, DCC No. 26..... .95
R-2505, DCC No. 28..... 1.15
R-2506, DCC No. 30..... 1.65

The following come on 4-ounce spools:

R-2507, GS No. 20.....$ .50
R-2508, GS No. 22..... .55
R-2509, GS No. 24..... .60
R-2510, GS No. 26..... .65
R-2511, GS No. 30..... 1.05
R-2512, GS No. 32..... 1.30
R-2513 GS No. 36..... 1.85

The following come on 8-ounce spools:

R-2514, E No. 20.....$ .45
R-2515, E No. 22..... .55
R-2516, E No. 24..... .60
R-2517, E No. 26..... .65
R-2518, E No. 30..... .70
R-2519, E No. 32..... .80
R-2520, E No. 36..... 1.00

LITZ WIRE

R-323, equals No. 25 B&S, per foot .....$.02
R-890, equals No. 28 B&S, per foot ..... .01
R-891, equals No. 21 B&S, per foot ..... .03
R-892, equals No. 20 B&S per foot ..... .04
R-893, equals No. 14 B&S, per foot ..... .12

Discounts of 10 per cent in 100-foot lots.

The "Rasco" Catalog

CONTAINS 75 VACUUM TUBE HOOK-UPS, 300 ILLUSTRATIONS 500 ARTICLES, 68 PAGES

All Armstrong Circuits: These important circuits are explained clearly, all values having been given leaving out nothing that could puzzle you.

Just to name a few of the Vacuum Tube circuits: The V.T. as a detector and one-step amplifier; armstrong circuits, one-step radio frequency amplifier and detector; three stage audio-frequency amplifier, short wave regenerative circuits; 4-stage radio frequency amplifiers; radio and audio frequency amplifier; inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; combination V.T. detector one stage amplifier; two stage radio frequency amplifier and detector with feedback coupling (regenerative); regenerative receiver, using single spider web coil; Armstrong super-regenerative circuit; two stage radio frequency amplifier coupled to a two-circuit tuner, using two-slide tuner regenerative receiver; two stage audio-frequency amplifier, using crystal or V.T.; one stage radio frequency detector, two stages audio-frequency with feed-back coupling to first tube; power amplifier with loud speaker; regenerative receiver and one stage amplifier for DX work; one stage radio frequency detector with feed-back coupling; three stages radio frequency, two stages audio-frequency loop reception; crystal detector with rectification; one tube super-regenerative receiver; short wave regenerative receiver with two variocouplers, capacity-coupled tuner; trap circuit to eliminate interference; selective circuit to eliminate interference The catalog contains 300 illustrations. On account of its great cost, it cannot be distributed free of charge. Mailed only upon receipt of

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See How Easily You Can Learn to Dance This New Way

If you can do the step illustrated in the chart in lower corner, there is no reason why you cannot easily and quickly master all of the latest steps through Arthur Murray's method of teaching dancing right in your own home.

Courtesy Metro Pictures Corp.
Scene from the famous screen version of "The Four Horsemen," showing Rodolph Valentino in one of the wonderful Tango steps.

NO matter how skeptical you may be about being able to learn to dance by mail, this new course will quickly prove to you that you can easily learn without a teacher on the ground to direct your steps—and without music or partner—right at home.

Even if you don't know one dance step from another, these new diagrams and simple instructions will enable you to learn any of the newest dances in an amazingly short time. You don't need to leave your own room—it isn't necessary to go into a dancing class—or to pay large fees for private instruction. All you need to do is to follow the instructions as shown on the diagrams, practice the steps a few times to fix them in your memory and there is no reason why you should not be able to dance on any floor, to either band or phonograph music, and to lead, follow and balance correctly, no matter how expert your partner may be.

Learn Any Dance in a Few Hours

Whether you want to learn the Fox Trot, One Step, Waltz, or any of the newer steps, you won't have the slightest difficulty in doing so through this new method. Then, the very next time dancing starts you can surprise your friends by choosing a partner and stepping right out with perfect confidence that every step you make and every movement is absolutely correct. Arthur Murray guarantees to teach you, or your lessons won't cost you one cent.

More than 90,000 people have learned to become perfect dancers by mail, and there is no reason why 90,000 more cannot learn just as easily. In fact, about one thousand people are becoming wonderful dancers through Arthur Murray's amazing new method.

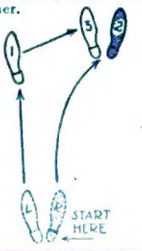
Good dancers are always the most popular people in their set—they never lack partners and are invited to every social event because dancing is the most popular form of recreation, and good dancers are always in demand. But besides this, good dancers always have perfect mental and physical control, ease of manner, poise, are never embarrassed, shy or timid. Very often they meet influential people in this social way who are very helpful to them in business.

Arthur Murray, Dancing Instructor to the Vanderbilts

FIRST PART
Forward Waltz Step

1. Begin with left foot and step directly forward, weight on left foot.
2. Step diagonally forward to right, placing weight on right foot (see illustration).
3. Draw left foot up to right foot, weight on left.

That's all. Simply follow the numbers in the foot-prints. Master this part before going further.



FREE
Tango Lesson

Arthur Murray has diagrammed the principal steps in the famous Tango as danced by Rodolph Valentino in such a simplified way that you can quickly and easily master this fascinating Tango, after you have the Murray foundation to your dancing. Send for this Tango today and you will soon be able to amaze all your friends with your ability to perfectly dance it.

Send No Money—Just the Coupon

FREE: The Fascinating Tango

Simply fill in and mail the coupon and Arthur Murray will immediately mail to you the complete 16-lesson dancing course. He will also send you FREE the complete diagrams for teaching you the tango that was danced in "The Four Horsemen," all just as we have explained it in this advertisement.

When your postman hands the special sixteen-lesson course to you, simply deposit only $1.00 with him, plus a few cents postage, in full payment. Keep the course for five days. Practice all of the steps, learn everything these sixteen lessons can teach you and prove to your full satisfaction that you have found the quickest, easiest, and most delightful way to learn to dance. Then, within five days, if you desire, you may return the course and your dollar will be promptly returned to you. But if you decide to keep the course—as you surely will—it becomes your personal property without further payments of any kind.

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To prove that I can learn to dance at home in one evening, you may send the sixteen-lesson course and the Fascinating FREE Tango in plain cover, and when my postman hands it to me I will deposit with him only $1.00, plus the few cents postage, in full payment. If, within five days, I decide to do so I may return the course and you will refund my money without question.

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